Remote Access Servers That Won't Quit

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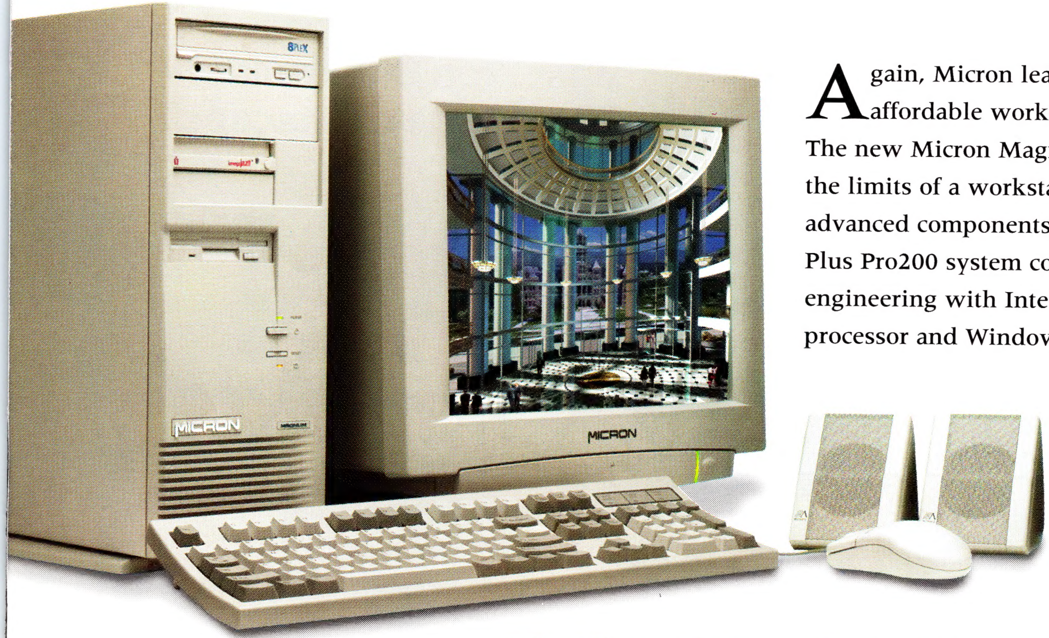
MAGNUM™ PRO AND



Again, Micron leads the industry by making affordable workstation performance a reality. The new Micron Magnum Plus Pro200 expands the limits of a workstation with the most advanced components available. The Magnum Plus Pro200 system combines superior Micron engineering with Intel's advanced Pentium® Pro processor and Windows® NT for the fastest, most reliable system on the market today. The Micron Magnum Plus Pro200—just what you'd expect from Micron Electronics, the technology leader.

> *"The Micron Magnum Plus Pro200 is the workstation to beat."*
>
> —*PC Magazine*, February 6, 1996

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- 16-bit stereo sound & speakers
- PCI 64-bit 3D video, MPEG, 2MB EDO
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- Microsoft Mouse, 104-key keyboard
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- Microsoft Office Pro 4.3 preloaded

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- Intel 133MHz Pentium processor
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- 3.5″ floppy drive
- PCI 64-bit graphics accelerator (2MB)
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- Microsoft DOS 6.22/Windows for Workgroups 3.11
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pentium
PROCESSOR

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PC MAGAZINE BEST OF 1995
January 9, 1996
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- *Tool-free* mini-tower or desktop
- Microsoft® Mouse, 104-key keyboard
- Microsoft Windows® 95 CD & MS Plus! CD
- 5-year/3-year Micron Power℠ warranty*

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PC MAGAZINE EDITORS' CHOICE
May 30, 1995
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MVP 1995 WINNER PC Computing
December 1995
MILLENNIA P133

MILLENNIA PLUS P166

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- PCI 32-bit Ultra SCSI Fast-20 controller
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- 16-bit stereo sound & speakers
- PCI 64-bit 3D video, MPEG, 2MB EDO
- *Tool-free* mini-tower or desktop
- Microsoft Mouse, 104-key keyboard
- Microsoft Windows 95 CD & MS Plus! CD
- Microsoft Office Pro 95 & Bookshelf 95 CDs
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intel inside pentium™ PROCESSOR

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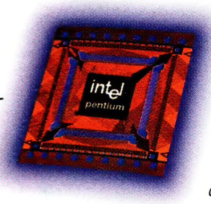

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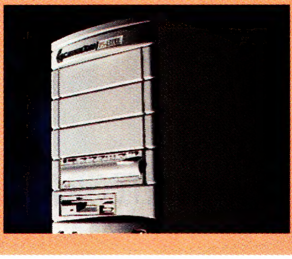

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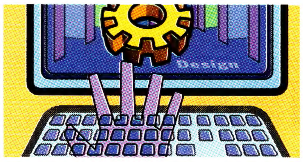

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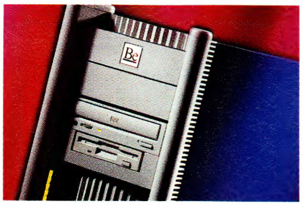

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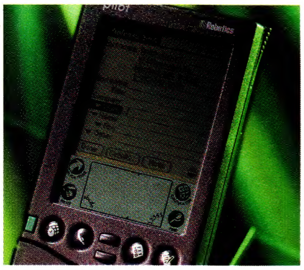

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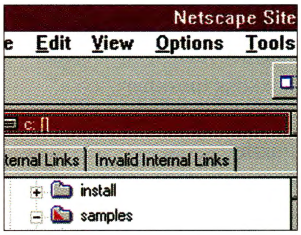

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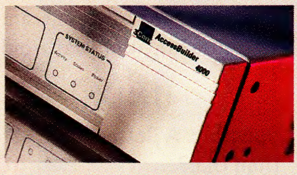

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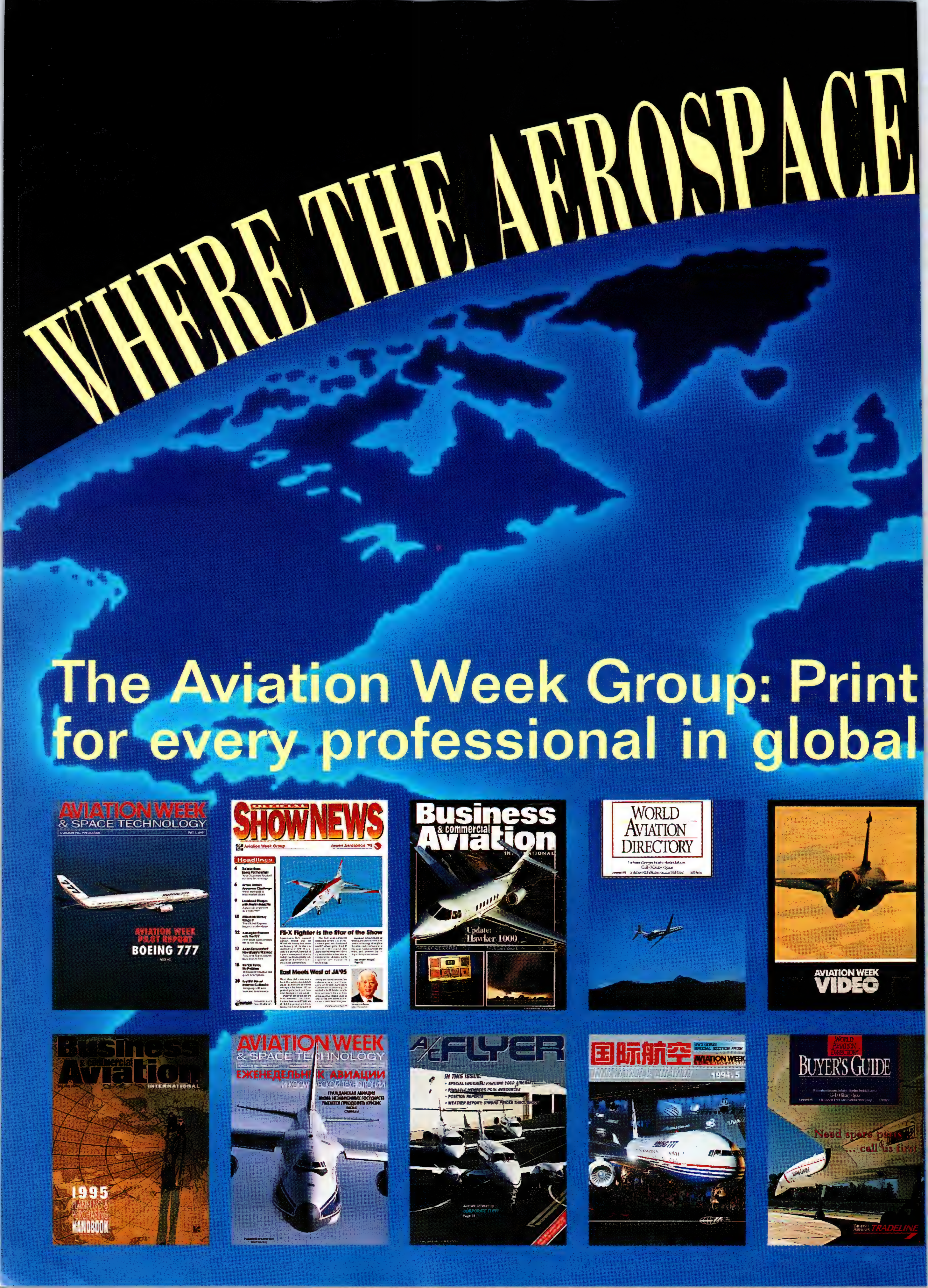
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AVIATION WEEK GROUP

editorial

Triumphant Technologists

Just flew in from Las Vegas and boy are my arms tired—mainly from lugging tons of Web brochures at the Networld + Interop show.

OK, I'm tired of all the hype, too. At the recent Networld + Interop show, I saw a modem marketed as "Internet Ready." Imagine that! Can we please trivialize this important technology just a little more? Maybe the Internet Engineering Task Force should hire Andre Agassi to do his "Image is everything" shtick for the Internet.

Sometimes, though, where there's sizzle there actually is steak. And nowhere is this more true than in the growing intranet movement. In this issue of BYTE, the next issue, and repeatedly over the next few months, we'll be digging into intranet technology to find its strengths and limits. Jon Udell, our Web Project editor, will be focusing on the intranet in his column for the coming year. He offers a lot of useful advice.

While you're absorbing all Jon's intranet goodies, consider this: Conventional wisdom has it that technologists have lost the momentum in steering corporate technology policy. Business managers are tired of that inward focus, according to this line of thought. Reengineering has put the technologists back where they "belong"—implementing other people's visions. Really? It sounds like somebody forgot to check who's driving the intranet, and where it's headed.

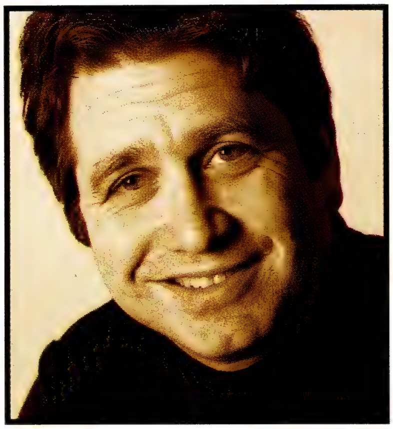
The intranet marks the resurgence of forward-looking technologists who have struggled mightily over the last decade to establish open distributed computing in the enterprise. Why? Not only, or even mainly, because they have a religious belief in standards. This movement has been about control: Computer users should control their resources. And they can do this only when they are able to exercise the ultimate sanction against vendors who produce products that don't meet their needs: Replace them. It's only the technologists in the corporate world who've had the vision to sort through claims like "Internet Ready" and establish long-lasting architectures that will survive both vendor and management attachment to various visions du jour.

The intranet is nothing less than an attempt to escape from the most onerous aspects of client/server computing as it has evolved to this point: dependence on expensive relational database management systems, lock-ins to proprietary 4GL environments, and the inability to write one application, one time, and have clients access it from any desktop anywhere.

That last point marks a big difference between the new, savvy Internet technologists and the gnu-savvy Unix diehards of only a few years ago: The former's vision is far more focused on giving the corporate end-user community what it wants, needs, and can afford, even when those same users don't quite know what those things are. Where did this new breed of technologist come from? Many are the old breed, grown wiser; some are Young Turks with no legacy to defend as yet.

The next time you hear somebody dissing the IT community for having no business sense, ask them which high-priced management consultant invented the intranet.

Will the intranet concept succeed totally? Not a chance. Is it always the right approach? As this month's cover story shows, not always, and not everywhere. But one thing's for sure—next time you hear somebody dissing the IT community for having no business sense, ask them which high-priced management consultant or smart CEO invented the intranet, thereby cutting application development times and slashing software license fees.



The products at this year's Networld + Interop certainly proved that today's technologist has learned his or her lesson. Keep the end users happy, align IT plans with business goals, and—oh yes, one more thing I learned in Las Vegas—never put all your money on one horse.

Mark Schlack

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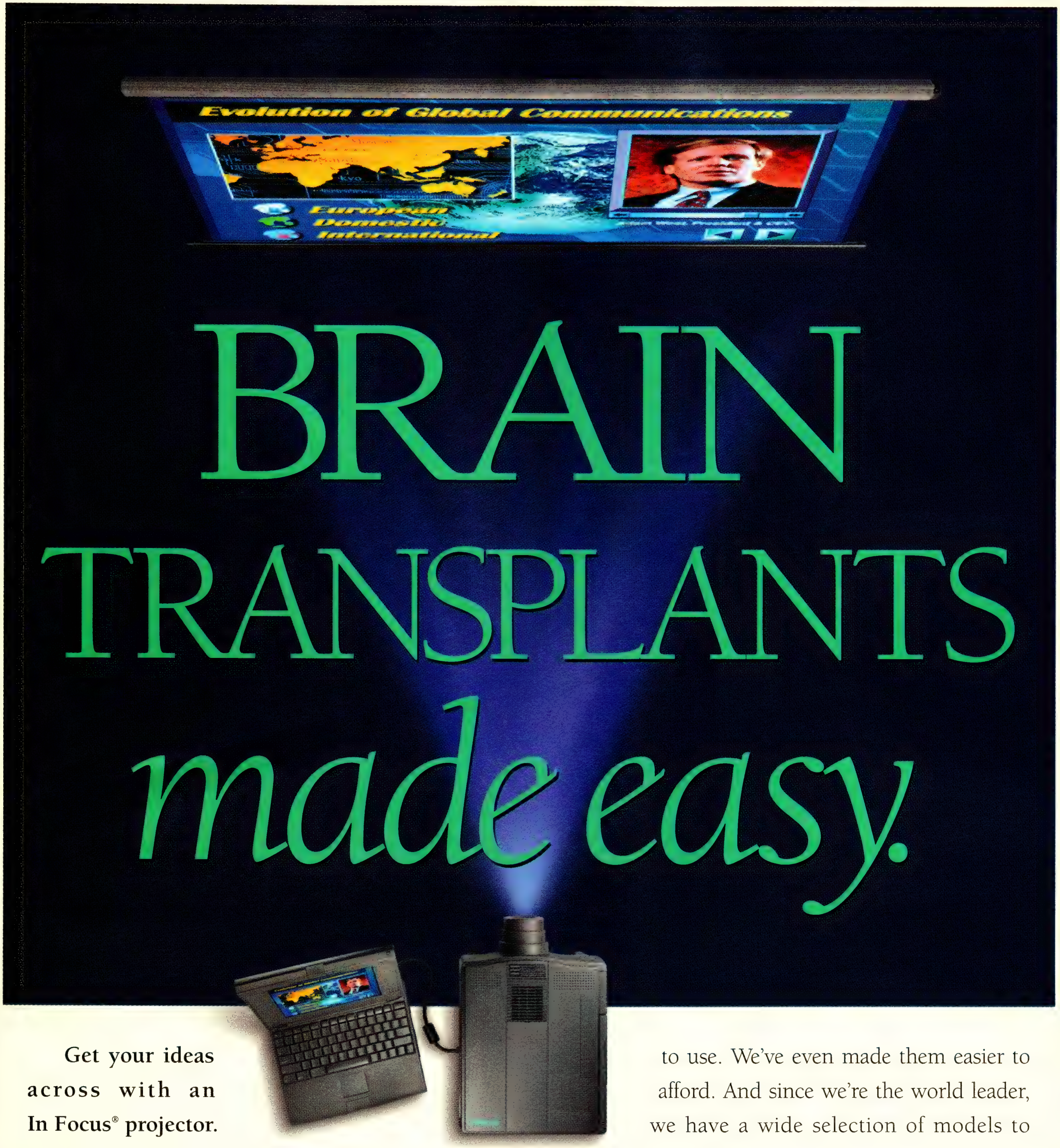

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inbox

Suitably Aligned

Thanks for the good article "Bug-Free Benchmarks" (March). We just introduced two instructions in some of our computational software to align the double-precision floating-point local structures to 8-byte boundaries within our stack. Incredibly, the overall performance of the program received a 20 percent boost. Shame on the compiler vendors who introduce more and more optimizing switches—which are often the source of trouble rather than benefits—but always forget the simple thing.
Roberto Verzoni
rover@mbox.vol.it

Unix vs. NT

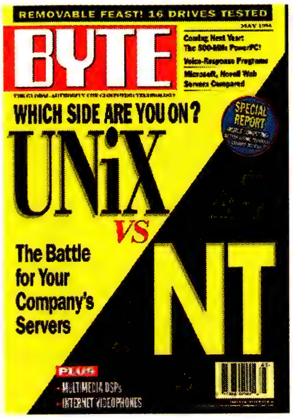
"Unix vs. Windows NT" (May cover story) was very well done and informative. However, you overlooked Linux, which definitely has potential in many organizations and is a more cost-effective OS for the x86 platform than Windows NT.
John Iliff
Pinellas Park Public Library
Pinellas Park, FL
http://pppl.tblc.lib.fl.us

It was not possible to consider all the flavors of Unix. I tried to keep my discussion generic, focusing on Sun in a few cases because of its status as a primary flag-bearer. Linux could be a good solution for some installations, but other businesses might be reluctant to adopt a Unix that is perhaps not as well supported by a single vendor as other variants, such as Solaris, AIX, or HP-UX. Some MIS directors want that "big business" relationship with their vendors. It costs more, but it makes them feel more comfortable.
—Tom R. Halfhill, senior editor

In the article on Unix vs. NT, you say, "Architectural limitations hobble low-priced x86-based servers when they try to tackle the really big jobs." Most of the rest of the article suggests that the reason x86 boxes running NT cannot keep up with Unix boxes is they do not have enough processor power, but that this can be fixed by improving NT's symmetric multiprocessing (SMP) scalability. I disagree. Benchmarks we performed in 1995 showed that NT experiences an I/O bottleneck long before it runs out of processor throughput.
Jonathan Handler
71702.1620@compuserve.com

I was talking about much more than CPU power—indeed, the Pentium Pro holds its own with the fastest RISC chips in terms of integer performance. The main limitations are system architectures and the inability of NT to scale linearly beyond six or eight processors in an SMP system. Unix is more scalable in this regard, and Unix servers tend to be built on superior system architectures that deliver higher overall performance. Of course, they usually cost a lot more, too.

In this issue of BYTE, we analyze two new server architectures that attempt to address this problem (see "The Network Inside the Server," page 151). One of them, Sequent's NUMA-Q, is based on the Pentium Pro and supports both a Unix variant (DYNIX/ptx) and NT.
—Tom R. Halfhill



Diminishing Return on RAM

In "120-MHz Pentium Power for Under $400" (April News & Views), you make several references to Intel's claims that processor upgrades deliver significantly better performance than RAM upgrades. Unless you are describing a trivial case, the same processes with the same memory requirements will see a marked improvement with the addition of RAM. The value of adding a new CPU is diminished by the fact that the real bottleneck is not CPU cycles; it is usually disk access. Adding RAM almost always helps relieve this bottleneck.
Sharif Abdallah
Cincinnati, OH
sharif@ibm.net

Adding RAM, especially to 2- or 4-MB systems, can improve performance. However, if you already have a lot of memory—e.g., 8 MB in a system running applications like Quicken—you reach a point of diminishing returns. —Dave Andrews, news editor

Trust the Web PC

"Inside the Web PC" (March cover story) was a great read

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and made many good points. But do you think computer users are going to trust their most sensitive data to the Net, where they will have to worry about both security and accessibility? Small hard drives neither cost nor weigh that much anymore. Can it be that we are really just talking about a new breed (with a new name) of cheap computer? What will a network computer really add that a cheap PowerBook can't?
Frode Hegland
www.liquid.org
frode@liquid.org

I expect that most "network computers" will have hard drives for caching software and storing local copies of user files, but the user won't have to manage the hard drive, any more than PC users today must manage the contents of their RAM-based disk cache.By caching copies of the OS and applications on a small hard drive, the NC can run faster. Most NC users won't store their files on the Internet. In corporations, universities, and even public schools, they'll store files on LAN servers, just like they probably do now. Users at home could store them on a local hard drive or on a secure server at their Internet service provider. This frightens some people, but consider: professionally maintained servers are backed up regularly; locally stored information is only as safe as the physical security of the device it's stored on; all the most sensitive information about your life—bank accounts, medical records, etc.—is already stored on network servers.

A PowerBook could indeed be used as an NC if the operating system and applications were replaced. Unfortunately, there's no such thing as a cheap PowerBook.—Tom R. Halfhill

Skewed Web Statistics

In "Damn Lies" (February Network Project) you described how you collected statistics on which operating system people were using to talk to your Web site by detecting the Web browser and deducing the OS from this. You go on to point out that a very small percentage of people were using WebExplorer from IBM and consequently there were very few people using OS/2. I currently use Netscape 2.0 in WinOS/2 with the IBM Internet Dialer dialing into Ireland Online as my local provider. I'd be curious to see how your results would differ if you bore WinOS/2 users like me in mind.
Robert Healy, VTI
www.vtilink.com]
bhealy@iol.ie

Actually I thought the 4 percent for WebExplorer was relatively impressive, being half the number for all implementations of Mosaic. But you're right—several readers have pointed out that WinOS/2 plus Netscape has in many cases superseded WebExplorer, so the true number of OS/2-based visitors is larger but unknown. Ideally Netscape would report in its version string if it were running in WinOS/2 rather than Windows. Since WinOS/2 really is Windows, though, that might not be possible.
—Jon Udell, executive editor

Join Local # 1

What is a Webmaster? Is it someone who just oversees a Web site? Someone who maintains e-mail? A programmer? Due to the vast gamut of jobs related to Internet site development and maintenance, we need another phrase. I propose "websetter" for a person who does Hypertext Markup Language (HTML) coding, Internet graphics, page design, and site maintenance. It would be in keeping with the well-known term "typesetter" and give people like me an accurate job description.
Scott Johnson
Soft-One Corporation
sjohnson@softone.com

Thanks, But No Thanks

Jeffrey Fritz's article "Marrying ISDN to the OS" (April) implies that by adding ISDN support to Windows 95, Microsoft has made ISDN easier to use and support. In fact, the contrary is true, at least in Europe, because Microsoft chose to ignore CAPI, the Common ISDN API that has been adopted by the European Telecommunications Standards Institute. Every PC ISDN card sold here comes with CAPI drivers for DOS and Windows, and many come with one for OS/2. Almost every ISDN application builds on the CAPI standard, from telephone-answering to fax to drivers for BBSes, packet or NDIS networking drivers, and on-line service access programs. Windows 95 is not only incapable of working with CAPI, it actually disrupts existing solutions by doing things its own way. Vendors, far from being able to "come to market faster and at lower cost," as your article asserts, now have to supply drivers supporting Windows 95 and CAPI in order to give users the functionality they are used to.
Tilman Schmidt
Bonn, Germany
tilman@schmidt.bn.eunet.de

In North America, the integration of ISDN into Windows 95 has made it easier—and probably cheaper—to use ISDN. While we may not agree with all their decisions (such as no Multilink PPP and limited compression support), Microsoft is one of the few vendors with enough clout to lead the way in improving ISDN deployment. I can understand why Microsoft's decision not to support CAPI would be considered a serious oversight in Europe. Unfortunately, CAPI has no widely accepted equivalent in North America. Ours is a fragmented environment where even ISDN network products that are supposed to work together frequently do not. We need a mammoth effort to correct this. That won't come from the U.S. or Canadian governments or from the Regional Bell Operating Companies. Microsoft's ISDN implementation is far from perfect, and much more work needs to be done; still, someone has to start somewhere. Credit Microsoft for being willing to try.—Jeffrey Fritz

ThinkPad Revisited

In your March review of IBM's ThinkPad 760CD, you noted that its graphics performance was considerably worse than a typical 90-MHz desktop at 600 by 800 resolution and with 8-bit color. When the 760CD is put into 8-bit mode, however, the "ThinkPad Features" program indicates that graphics acceleration as well as

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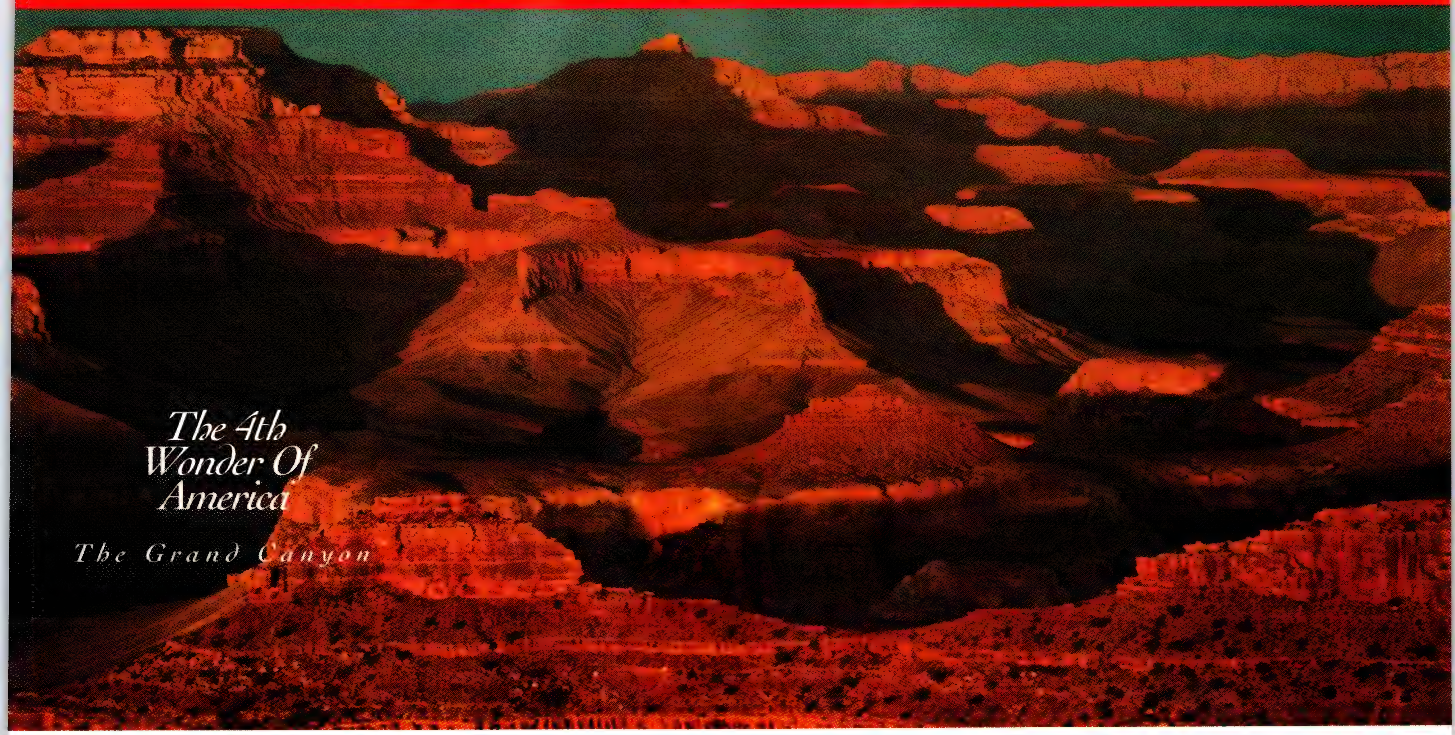

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MPEG is disabled; they can be enabled only in 16-bit mode. It would be interesting if you could rerun your test in 16-bit mode. It may be that the ThinkPad is actually faster in that mode.

Henry Kautz
AT&T Research,
Murray Hill, NJ
kautz@research.att.com

While our published benchmark tests were done using 8-bit color, because that's what we had available to compare against, I used the machine primarily in 16-bit color mode for some time afterward. And, subjectively at least, it was not detectably faster in that mode. I also did a few runs of our scripted performance tests using 16-bit color and didn't observe any speedup at all. —Russell Kay, technical editor

FIXES

The caption for the screen shot on page 64NA 6 of "When COBOL is Cool" (April) describes Animator running under COBOL Workbench for Windows. The screen shows Animator running under OS/2.

In "R5000 Cuts 3-D Cost" (April News & Views), we neglected to point out that the R5000 was actually designed by Quantum Effect Design (www.qed-inc.com).

COMING UP IN AUGUST

COVER STORY:

WEB SITE DEVELOPMENT

IS professionals charged with designing Web sites, creating Web-based conferencing systems, and planning for future applications are bombarded by as much hype as useful information. Jon Udell presents a hands-on analysis of the important tools, techniques, and trends, using lessons he's learned as the creator of www.byte.com.

STATE OF THE ART:

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Does your company need ATM now? How do you make the right choices about protocols, bandwidths, emulations? We examine strategies for implementing this technology, plus what developers need to do to write ATM applications.

REVIEWS:

HARDWARE LAB REPORT

NSTL tests tape libraries for high-volume data backup, including DLT, 8mm, and DAT tape drives.

ULTRASCSI HOST ADAPTERS

The emerging UltraSCSI standard will let high-performance hard drives and other peripherals communicate at up to 40MBps—twice the current limit. We examine the adapter boards that can make it happen.

IBM THINKPAD 560

Big Blue's popular notebook line slims down. We test one of the first of the new ultrathin notebook PCs.

CORE:

PROGRAMMING: MORE ON MMX

We present guidelines for writing to Intel's new MMX instruction set for the x86 architecture.

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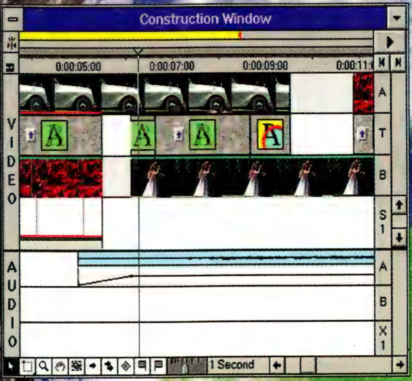

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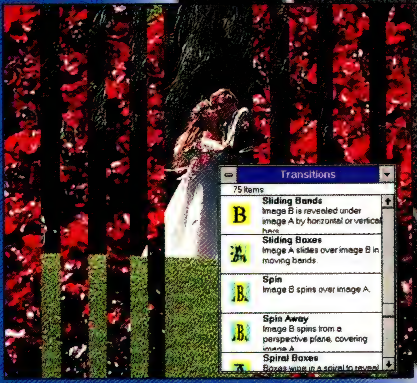

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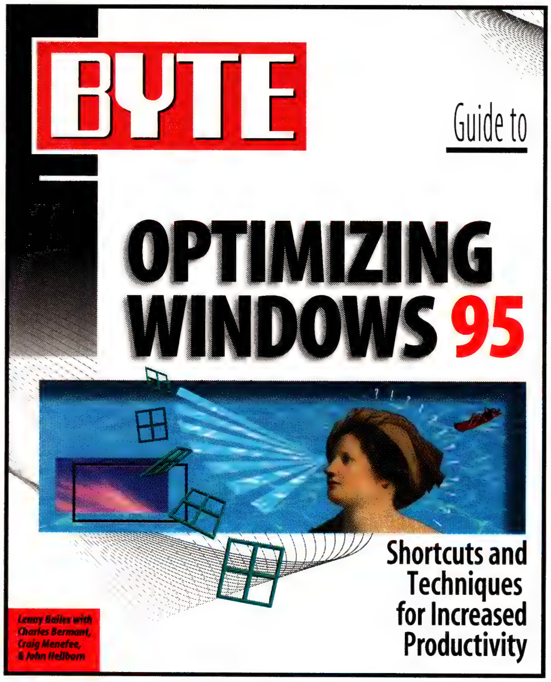
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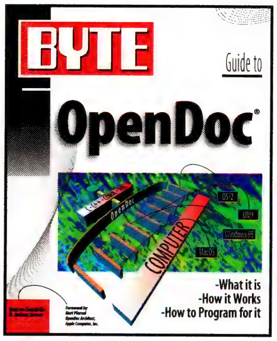

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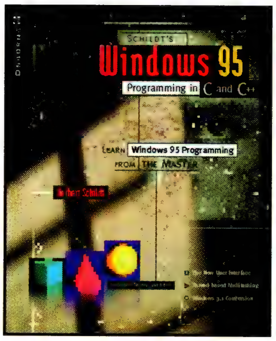

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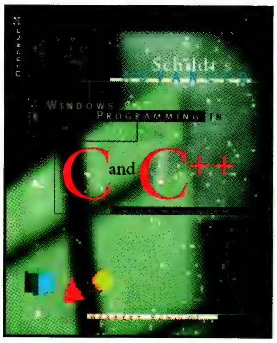

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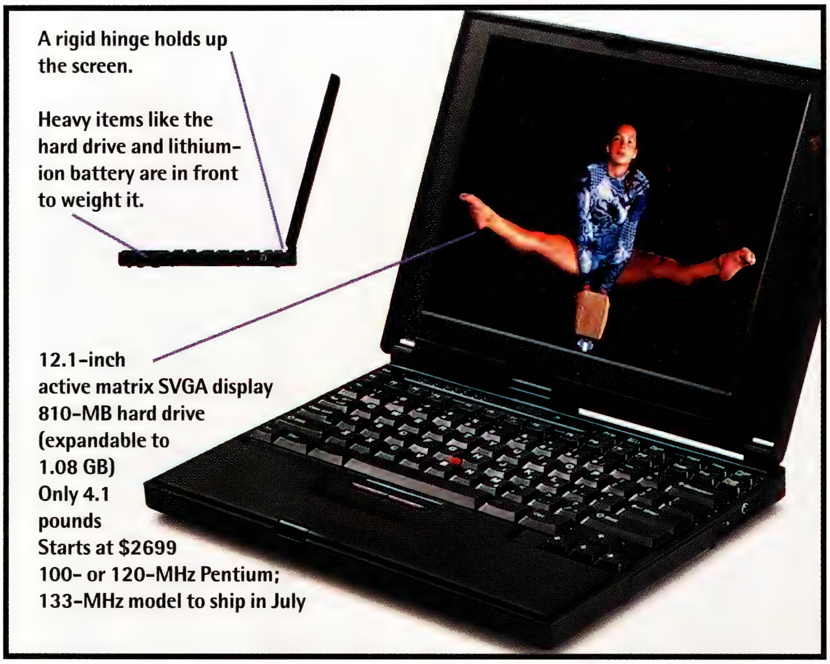
Richer, Thinner Notebooks Arrive

Although not quite paper thin and paper light, new notebooks offer many features found in heavier high-end portables.

New ultraportable yet powerful notebooks will hit the market this year, and these thin models are much richer in features than subnotebooks of two years ago. An early contender in the new thin-and-wide notebook format is the HiNote UltraII from Digital Equipment (800-642-4532 or 508-460-8894). Available with up to a 133-MHz Pentium, the new HiNote measures 8½ by 11 by 1.1 inches and weighs just 3.9 pounds (an optional CD-ROM drive add-on weighs about 2 pounds). The SVGA version starts at $3999.

The new ThinkPad 560 from IBM (800-772-2227) betters the HiNote's 10.4-inch SVGA display with a 12.1-inch screen and a wide range of features (see the photo). NEC Technologies (Mountain View, CA), Compaq (Houston, TX), and other vendors are expected to announce slim notebooks as well. Although they offer big displays and hard drive capacity, these new ultraslim notebooks don't have everything. Unlike other ThinkPads, for example, the 560 doesn't have an internal CD-ROM drive as an option.


A rigid hinge holds up the screen.
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12.1-inch active matrix SVGA display
810-MB hard drive (expandable to 1.08 GB)
Only 4.1 pounds
Starts at $2699
100- or 120-MHz Pentium; 133-MHz model to ship in July

IBM's ThinkPad 560

"This new type of thin notebook is designed to satisfy the user who is sensitive to size and weight in their notebook," says Eric Shuster, business unit manager for value portables at Compaq. The company reportedly will release later this summer a thin notebook with a flexible design. "But unlike before, these new notebooks satisfy budget-conscious and many power users."

Shuster advises buyers of slim notebooks to check: screen size; keyboard design (Is it full size? Does it have arrow keys in an inverted T?); battery life and power management; RAM expandability; pointing device options; and upgrade options. Users wanting many features may have to get a heavier notebook.

And what of even wider designs? Compaq says the 12.1-inch size will remain mainstream this year. Kevin Clark, product manager for mobile marketing at IBM (Research Triangle Park, NC), agrees. "We're not seeing a demand for anything larger than the A4 paper size."

– Dave Andrews

geek mystique

Think you type fast? Michael Shestov, Guinness Book world champion of error-free speed typing, can enter the numbers 1 to 801 without a single mistake within five minutes.

As contact between man and computer increases, so does the need to make computers more accessible. To address the growing field of human/computer interaction, DePaul University (Chicago) now offers an undergraduate degree program that combines the disciplines of computer science, psychology, and graphic design. For more information, see www.depaul.edu/programs/cs.html.

How's your emotional IQ? In addition to street smarts and book smarts, employers such as Enterprise Rent-A-Car now evaluate prospective employees on qualities such as self-confidence, empathy, and social awareness.

If you're interested, you can test your emotional quotient yourself on Enterprise's Web page at www.erac.com.

Geoprocessing Goes Prime Time

Driven by new geographic data sources, improved software, and widespread need, geodata and geoprocessing are becoming big business. Between 60 percent and 80 percent of all database records have a geographic field (usually a street address), and new features in programs such as Oracle enable them to store more complex geographic data.

The need to support geodata is increasing. Within a decade, geographic positioning system (GPS) microchips will be in almost all new vehicles, cell phones, farm and construction equipment, and large shipping containers. Twelve new high-resolution commercial Earth imaging satellites will be on-line by the year 2000. Traditional geodata and geoprocessing markets are growing, and new applications are proliferating in banking, insurance, retailing, and other areas.

More than 60 organizations have joined the Open GIS Consortium (OGC, Wayland, MA), which is writing the Open Geodata Interoperability Specification (OGIS). The group's overall goal is to bring geoprocessing into the world of open systems and distributed heterogeneous computing. Part I of OGIS, The OpenGIS Guide, is available on the Web at http://ogis.org.

"Monolithic software systems and closed and incompatible data formats have limited GIS, Earth imaging, and other geoprocessing technologies to the status of cottage industries," says Carl Reed, president of geographic information system (GIS) software vendor Genasys (Fort Collins, CO). "OGIS will change that."

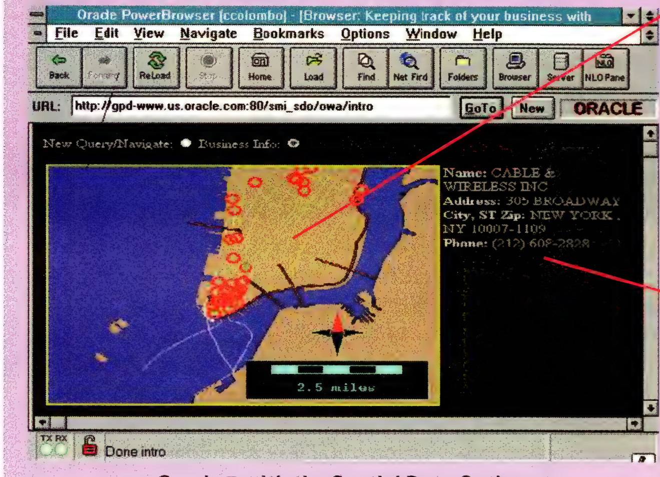
OGC's Technical Committee has created the basic elements of a platform-independent OGIS specification. Through a request-for-proposals process, the technical committee and vendors are now creating implementation specifications for distributed computing platforms, such as OLE/COM, the Common Object Request Broker Architecture (CORBA), and Java. OGC's new Application Integration Working Group will give government and industry "geographic information communities" expert analysis and assistance on their geoprocessing issues.

Even the historical division between the raster and vector worlds is dissolving. OGIS will contain a comprehensive Earth imaging model to unify raster images of weather, land masses, and other geographic entities with vector representations typically found in CAD and graphics applications. Ultimately, OGIS will support sophisticated real-time raster-to-vector conversions (e.g., taking an aerial photograph and using image recognition to interpret roads that can be layered into CAD drawings) and other kinds of "in the pipe" processing.

As the OGC tears down proprietary barriers, integrators will be able to quickly and economically spatially enable applications for both business and government agencies.

–Lance McKee

1. Spatial data will flow more freely through the corporate information system and the NII when the data is a standard component of open, platform-independent database technology. Here Oracle PowerBrowser shows the results of a database query, but any browser could display this information.



Oracle PowerBrowser [ccolombo] - [Browser: Keeping track of your business with

URL: http://gpd-www.us.oracle.com:80/smi_sdo/owa/intro

Name: CABLE & WIRELESS INC
Address: 305 BROADWAY
City, ST Zip: NEW YORK, NY 10007-1109
Phone: (212) 608-2828

2. The user queried the database for all companies in a certain industry within a 2.5-mile radius in New York City.

3. Clicking on one of the database hits, represented by a circle, yields specific business data.

Oracle 7 with the Spatial Data Option.

yeah, but...

The paperless office is approaching reality. Industry analysts estimate that the amount of printed information workers deal with will decline from about 70 percent today to about 30 percent in the year 2004.

Yeah, but analysts and vendors like Hewlett-Packard also say the amount of information we'll have to process will double every seven years. Even though we'll print less often, we'll still print a lot.

Copiers break down often. Instead of photocopying memos, we will e-mail them.

Yeah, but laser printers are fairly reliable, and people will still want to print: paper is portable, and it's easy to mark it up. Look for mopiers, which are fast laser printers that quickly make multiple prints, to supplant today's photocopier.

People who talk about distributed printing over the Internet ignore the lack of standards that prevents this.

Yeah, but the World Wide Web Consortium is addressing these issues to make distributed printing easier. You can bet that delivery companies are investigating how they will integrate distributed printing into their overnight delivery services.

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Micromirrors Project Better Images

Usually mirrors reflect an image, but a new technology five years in development at Texas Instruments (Dallas, TX) uses mirrors to create an image. The result of TI's Digital Light Processing (DLP) subsystem—now appearing in new PC projection systems—is bright, crisp output that's also visible from side viewing angles. And perhaps by this time next year, TI will have similar subsystems for high-quality color printers. The DLP technology is being used by In Focus Systems (Wilsonville, OR, 503-685-8888), Proxima (San Diego, CA, 619-457-5500), Nview (Newport News, VA, 804-873-1354), and other makers of projection devices for personal computers.

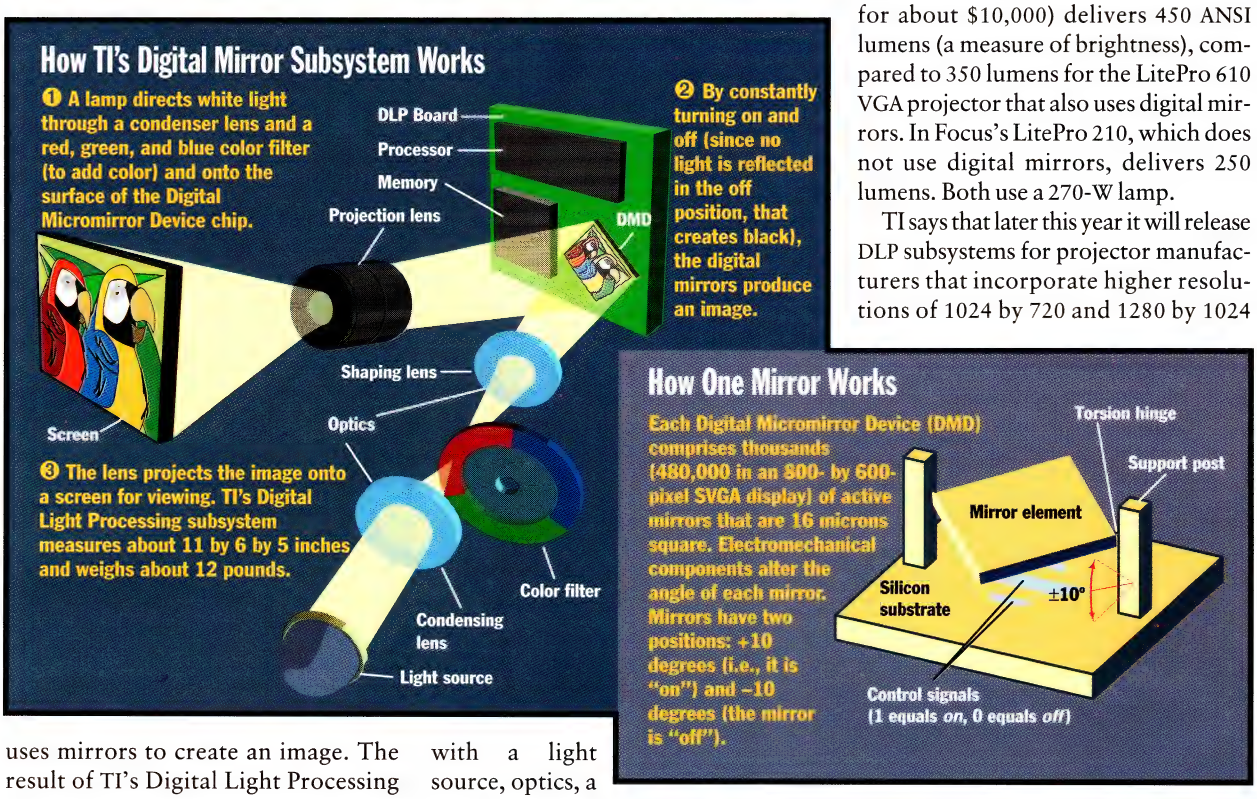
TI's DLP subsystem is based on the company's Digital Micromirror Device, a microchip upon which thousands of tiny aluminum micromirrors that rest on miniature hinges flutter on and off hundreds of times a second. The micromirrors' ability to turn on and off at lightning speed, when used in conjunction with a light source, optics, a revolving color wheel, and projection lens (as shown in the two diagrams), creates projected images that are easily visible even in a room that's fairly well lit.

A fundamental advantage of the technology is that unlike LCD technology, in which light must pass through the screen, digital mirrors create images by reflecting light, which results in a brighter image. With digital mirrors, and unlike LCDs, brightness increases as resolution increases. "With LCD technology, increasing your resolution requires bigger light sources to maintain the same level of brightness," says Ken Knepper, senior product line manager at In Focus Systems, which was expected to release in June the LitePro 620, an SVGA projector featuring TI's DLP subsystem. The LitePro 620 (weighs 21 pounds and sells for about $10,000) delivers 450 ANSI lumens (a measure of brightness), compared to 350 lumens for the LitePro 610 VGA projector that also uses digital mirrors. In Focus's LitePro 210, which does not use digital mirrors, delivers 250 lumens. Both use a 270-W lamp.

TI says that later this year it will release DLP subsystems for projector manufacturers that incorporate higher resolutions of 1024 by 720 and 1280 by 1024 pixels. The company is planning two- and three-chip systems that offer brighter images and more vivid colors.

Other uses for digital mirrors include projectors for large venues like concert theaters and home theaters, plus desktop monitors. If TI delivers on its expectations, you'll be seeing mirrors in a lot of places besides your bedroom.

– Dave Andrews



How TI's Digital Mirror Subsystem Works

① A lamp directs white light through a condenser lens and a red, green, and blue color filter (to add color) and onto the surface of the Digital Micromirror Device chip.

② By constantly turning on and off (since no light is reflected in the off position, that creates black), the digital mirrors produce an image.

③ The lens projects the image onto a screen for viewing. TI's Digital Light Processing subsystem measures about 11 by 6 by 5 inches and weighs about 12 pounds.

How One Mirror Works

Each Digital Micromirror Device (DMD) comprises thousands (480,000 in an 800- by 600-pixel SVGA display) of active mirrors that are 16 microns square. Electromechanical components alter the angle of each mirror. Mirrors have two positions: +10 degrees (i.e., it is "on") and –10 degrees (the mirror is "off").

future watch

Thanks to new manufacturing facilities, choosing a thin LCD over a bulky CRT won't gouge your wallet quite as much.

LCDs have numerous advantages over CRT monitors, including a smaller footprint, lighter weight, and lower power consumption, but they are also more expensive. LCD makers such as Sharp are expected to address the price issue this year. Sharp says its new third-generation manufacturing facility lets the company mass-produce large-format LCDs for desktop PCs. Competitors such as Hitachi and Fujitsu have similar plans. Sharp hopes that in 1997, when active matrix LCD prices drop to about three times that of CRTs, it will capture at least 5 percent of the desktop monitor market, and 15 percent when prices drop to twofold over CRTs.

"I don't see a move to flat panels happening in the desktop market as quickly as our point-of-sale or industrial control environments because the business desktop market is more price sensitive," says Scott Hagermoser, product manager at MicroTouch Systems, a maker of touch-input devices. Once prices come down, announcements of systems that combine an LCD monitor, CPU, and scanner keyboard will become more commonplace.

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OpenDoc: A Better OLE than OLE?

Among Windows software developers, Microsoft's Object Linking and Embedding technology is the standard for interapplication communication. One of OLE's strengths is its tight integration with the underlying Windows architecture. But the Windows-dependent nature of OLE has opened a window of opportunity for a new architecture.

OpenDoc is attracting attention as a cross-platform component technology. (See "OpenDoc Says OLE to Developers" on page 49 in this issue.) Control of OpenDoc standards has been invested in Component Integration Labs, a nonprofit industry consortium founded by Apple, IBM, and Novell. And OpenDoc has recently been incorporated into the Common Object Request Broker Architecture (CORBA) standard.

Apple was first to deliver OpenDoc, shipping version 1.0 for the Mac OS in 1995. But although Mac developers are interested in OpenDoc, many are taking a wait-and-see attitude, says Stefan Wennik, manager of marketing and communication at Bitstream (Cambridge, MA). "When we talk to Macintosh developers and ask if they need our products as OpenDoc components, we get blank stares," Wennik said. "We love the idea, but I don't think anyone needs this stuff in a big way right now."

Mac developers are interested in OpenDoc, but there's currently little incentive to support it, according to Karl Cremin, senior analyst at MindShare. "To the end user, the value of an OpenDoc component is being able to use it in an application," Cremin said. "Support in big applications is the key to OpenDoc's success among Mac developers."

Converting Mac developers to OpenDoc is not enough to establish a cross-platform standard. IBM recognizes this and now offers OpenDoc for OS/2 3.0, with versions for AIX (currently in beta) and Win 95 and NT (to enter beta in June) expected to ship later this year. IBM will make the Windows OpenDoc toolkits available for free downloading at www.software.ibm.com/clubopendoc.

IBM is implementing OpenDoc under Windows in part to woo OLE developers. But IBM is attempting to underplay the idea of a face-off between OpenDoc and OLE. "We're not saying, 'Don't do OLE,'" says Scott Hebner, manager of OpenDoc marketing development at IBM. "Instead, we're saying that OpenDoc provides a much better way to build OLE into your Windows applications."

Hebner admits that developers creating applications exclusively for single-user Windows platforms gain little by embracing OpenDoc. But for cross-platform applications, using OpenDoc to implement OLE greatly increases the services available to an application, he says.

To complicate choices even further, the chances that OLE may be available on different platforms is definitely increasing. Bristol Technology (Ridgefield, CT, 203-438-6969, www.bristol.com), a strategic partner with Microsoft, is now shipping its Wind/U Win32 cross-platform development kit. Appearing as a set of shared libraries, the new Bristol product makes OLE functionality a reality under Unix.

"OLE has become so easy to use," said Ken Blackwell, chief technical officer at Bristol, "that it's now an integral part of most Windows applications. Commenting out the OLE code when porting to Unix, a common practice in the past, is simply no longer practical." For Windows developers, Blackwell noted, OpenDoc is a future target, whereas OLE is something they've grown up with. By providing OLE under Unix, he added, there's nothing for them to relearn.

Another contender is Next Software (Redwood City, CA), which has developed products that integrate OLE and CORBA. "Customers building multitiered cross-platform applications also have to integrate CORBA to OLE," says David Butler, Next's director of enterprise product marketing. "Our D'OLE and PDO products provide object model independence and enable that integration." D'OLE, available now for NT, will support Win 95 this summer. And Next's offerings support versions of Unix from Sun, Digital, and HP, not just IBM's AIX.

Whether a single object architecture will dominate remains to be seen. Mac developers are apt to embrace OpenDoc; Windows developers continue to evolve with OLE. Developers may have to accommodate more than one standard.

– Rob Hummel

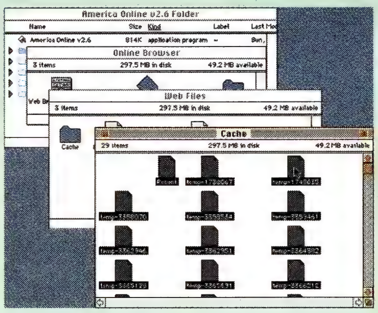
Bug of the Month

Empty the Cache into the Trash

America Online's Web browser for the Mac doesn't support all the goodies you find in other browsers, such as RealAudio and cutting and pasting portions of a Web page to your computer, and sometimes the browser won't work at all. Users have reported that one minute the browser works fine, and the next minute, when they click on the Web icon, the pointer turns into the rotating circle, then nothing happens. Here's one possible fix.

Go into the America Online v2.6 folder, then click successively through the Online Browser/Web Files/Cache folders (see screen shot). Select everything in the cache, then empty it into the Mac trashcan.

AOL says the browser occasionally fails because of the program's caching scheme.



If you cache a bad Web page (e.g., one where the link is broken), the AOL browser stops working without providing any feedback to the user.

You could also fix this problem by getting another browser or another Internet service provider. At least version 2.7 of AOL for the Macintosh adds support for cut and paste.

–Dave Andrews

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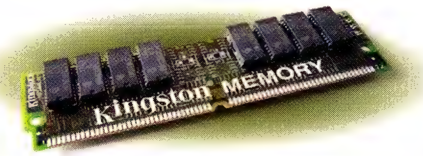

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Circle 70 on Inquiry Card (RESELLERS: 71).

Ten Reasons to Buy Duplex Printers

A duplex printer automatically prints on both sides of a piece of paper. Here's why you should think about replacing your old-fashioned single-sided printers with money-saving duplex models:

1. Demand for paper is rising sharply. According to the Paper Task Force report of the Environmental Defense Fund, "one forecast is that between 1990 and 2000, worldwide demand for paper will grow from 264 million short tons to 369 million short tons."

2. The global supply of wood pulp can't keep up with demand. The exploding human population is reducing the area of Earth's forests by 17 million hectares, or about half the size of Finland, per year, according to the Worldwatch Institute.

3. Expanding demand + restricted supply = higher prices.

4. Duplexers print both sides automatically, unlike most simplex laser printers.

5. Duplex printers save time and reduce waste. In a typical office, producing double-sided output is a two-step process. First, you print single-sided originals, then you march to the copy machine and turn them into double-sided copies. Once the copies are made, the original printout gets trashed.

6. Duplex printers save space (and money). By halving the number of pages, you pay less for courier services and postage, and you need fewer file cabinets and less space for document storage.

7. Duplex printers provide a competitive edge. If you use a lot of paper, simplex printers can reduce profits.

8. Two-sided documents are becoming more common. For example, phone bills are printed on two sides.

9. Duplex printers are affordable.

10. It's the right thing to do.

Survey

ISDN: The Good, Bad, and Ugly

ISDN offers higher bandwidth than V.34 analog modems, but based on comments collected from this month's BYTE survey, ISDN is still a very immature technology in parts of the world.

Comments from Europe, especially the Netherlands, Germany, and Switzerland, were generally positive. Except for a common complaint of problems either getting or installing Windows 95 drivers, most respondents in Europe said they are happy with ISDN. ("It's exactly what I wanted in order to get on the Internet," said one user from Germany.) Another common complaint: incompatibility problems when attempting to connect outside of Europe.

The situation in the U.S. is much dicier. Certain regions do better than others. Users in the West Coast area serviced by PacBell said they are generally (but not always) happy with installation and support. But readers from other parts of the country posted lengthy horror stories that seem straight out of a *Dilbert* comic strip. Others said ISDN is still too expensive.

Based on comments from real people actually using ISDN, here's a list of things to consider before adopting it:

- If you use Windows 95, make sure your ISDN terminal adapter's Win 95 drivers are available.
- Ensure that your Internet service provider, and not just your phone company, is ISDN-ready.
- Be patient as you work through initial configuration problems. Many users have problems at first but say they are happy upon successful connection.
- Do your homework. You may know more about ISDN than your phone company representative.
- Try to get an ISDN terminal adapter with automatic reconnect; otherwise you'll have to manually reset it after a power outage or packet fault.

Codetalk

by Rick Grehan

A Complete Trilogy of Visual Basic Tools

Code Complete is a triad of visual programming tools from MicroHelp that's primarily aimed at Visual Basic developers. Code Complete is simultaneously eclectic and useful. First in the suite is Code Analyst. A three-trick pony, Code Analyst provides cross-referencing, standards review, and code compression. The cross-referencing capability is a reporting facility that reveals information such as which routine calls which other routine, which routine references which variables, and how each variable is typed.

With the code-review form viewer, you can pull up a VB form and examine its overall layout of controls. (I say "overall" because the viewer is definitely not WYSIWYG; controls are uniformly represented by flat rectangles.) Code Analyst's code review also lets you check for standards adherence. I passed a VB project through the review, and it correctly caught a variable that had "excess scope" (the variable was referenced in only one routine and unnecessarily defined as a global).

Code Analyst's compressor grinds through your code, pulling out uncalled routines and unreferenced variables. This is not as frightening as it sounds. Code Analyst doesn't overwrite existing source; it copies the modified source into a new project.

The AutoCoder module, which installs itself as a VB add-in, manages "template scripts" that are governed by "rules." You unleash AutoCoder on your program and, if a particular rule fires, the associated script runs. So, you might define a rule that searches routines for error handlers; if it finds a routine sans handler, an "error handler writing" script is activated that automatically writes the handler for you. Some rules and scripts are provided. You can create more to your heart's content.

Splash Wizard is not as tied to Visual Basic as are the other components. It's a kind of executable wrapper that checks a system for requirements that you specify before installing the program.

Though you can purchase any component separately, the package deal, $249, is best. If you're seriously into VB work, this is a good set of back-end tools.

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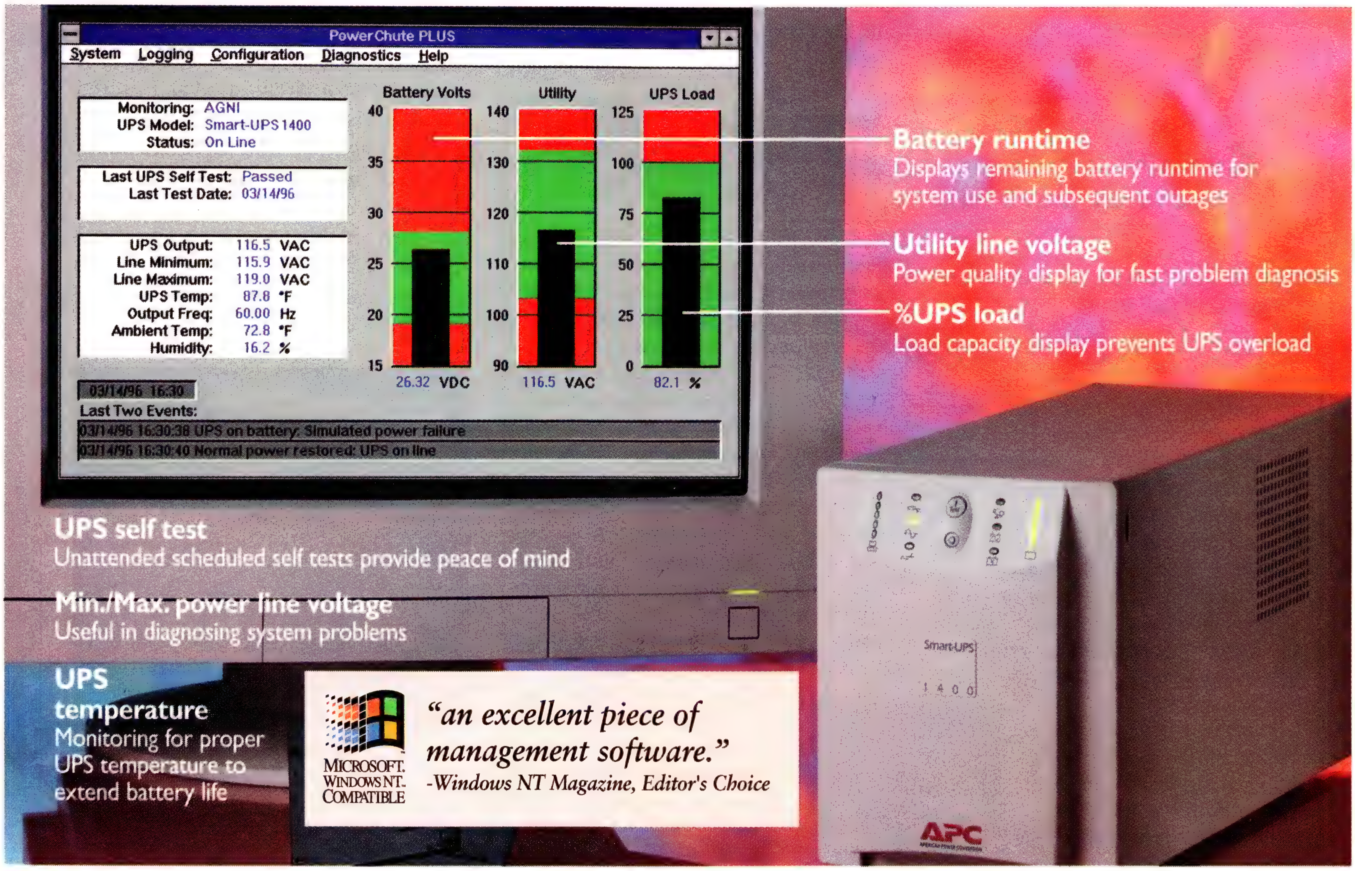

Monitoring: AGNI
UPS Model: Smart-UPS 1400
Status: On Line

Last UPS Self Test: Passed
Last Test Date: 03/14/96

UPS Output: 116.5 VAC
Line Minimum: 115.9 VAC
Line Maximum: 119.0 VAC
UPS Temp: 87.8 °F
Output Freq: 60.00 Hz
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Humidity: 16.2 %

26.32 VDC
116.5 VAC
82.1 %

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Last Two Events:
03/14/96 16:30:38 UPS on battery: Simulated power failure
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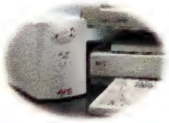

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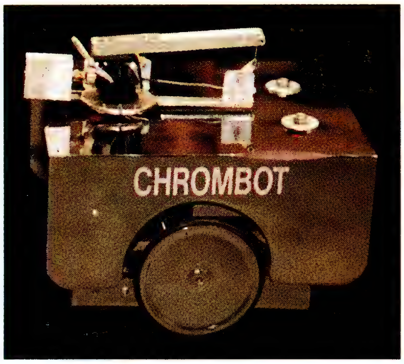
RoboCop, Meet Robo Fire Fighter

The future of home fire prevention could involve more than smoke detectors and hand-held extinguishers. Robots could be coming to the rescue. So says Jake Mendelssohn, founder of the Fire Fighting Home Robot Contest. Now in its third year, the competition, recently hosted by Trinity College (Hartford, CT), drew more than 50 contestants from as far away as Israel.

Entrants must program an autonomous robot to travel through a predetermined path in a maze, avoid obstacles, and seek out and extinguish a lit candle. Each robot is activated by a 3.5-KHz signal that emulates a sounding smoke detector.

This year's winner, aptly named ChromBot, came from a team of six senior robotics students at Central Connecticut State University. The ChromBot used an Intel 8052AH-based microcontroller to seek out and extinguish the candle. The designers programmed it with Basic52. For navigation, a Z80-based controller directed stepping drive motors. A flame-detector circuit used an infrared phototransistor as a sensor, and the extinguisher was made from a bicycle pump that contained a CO_2 cartridge. Most of the electronics parts used in the ChromBot are available from Alpha Products (Fairfield, CT). Robert Thompson, the winning team's professor, estimates the ChromBot cost about $1000 to build.



The flame-fighting ChromBot

Although more expensive robots are already used to perform tasks that are dangerous or impossible for humans (e.g., exploring hazardous waste sites), Thompson remains unsure of the future of robots in home fire prevention, despite the performance of the ChromBot. Unlike the contest robots, real-world robots would have to thrive in highly unstructured environments involving obstacles and stairs. The price of such a robot would be beyond most home owners. "Robots are tremendous for learning how to solve problems, but don't expect that these machines will be on the market anytime soon," Thompson says. "If you really want to do this in a cost effective system, put a sprinkler system in."

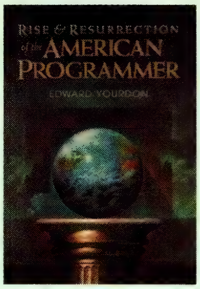
Nevertheless, research continues on robots in a variety of disciplines, including home health care (see this month's BYTE interview). And the lessons learned by today's research might just show up in the home of the future.

– Michael Bradley

book reviews

Good News for Cowboys

We work in an industry never far from chaos. Here on the software technology frontier, those who can adapt quickly find opportunity for spectacular success; those who can't are quickly left behind. That's the argument put forth by software engineering expert Edward Yourdon in Rise and Resurrection of the American Programmer. In his new book, Yourdon is as optimistic about the future of the American software industry as he was pessimistic in his 1992 Decline and Fall of the American Programmer. The rapid pace of technological development and the advantages Americans enjoy in responding to these transitions drive this change in outlook.



Begin by writing off commodity software. Yourdon's arguments in Decline and Fall about the threat of higher-quality software produced inexpensively in India and other nations still count, and Rise and Resurrection doesn't contradict them. But the new book notes that the impact of offshore competition is limited primarily to well-defined problems that require big programming teams but differ little from one implementation to the next. On these commodity jobs the overwhelming productivity advantages of offshore programmers compel customers to consider bypassing American coders.

It's beyond the commodities, writes Yourdon, where American developers can make up the difference: on fast-changing shrink-wrap software, on active Internet applications, on smart-home systems. The American programmer's greatest advantage is better access to the American software market, the world's largest. Better access means simple proximity to customers, but it also means speaking the same language, familiarity with consumer technology, and knowledge of cultural preferences. In an era when customization and rapid response to customer demands are increasingly important, this is an overwhelming edge.

"Cowboy" culture, too, plays a role in Yourdon's optimism. He devotes a chapter to the topic of "good enough" software, where the number of defects is simply another trade-off to balance against delivery schedules and features lists. In Yourdon's view, the strategies required to implement a good-enough approach work better in America's individualistic, "cowboy" culture than in cultures that are more comfortable with rigorous top-down control.

Although Rise and Resurrection outlines these advantages, this is more a book about how American programmers can succeed than one about why they will. Yourdon describes process engineering strategies for today's turbulent environment, where layoffs are commonplace and corporate loyalty virtually nonexistent. Here, the emphasis is on individual improvement and on realizing the importance of talented team members. The author devotes a chapter to applying process models to one-person projects.

For American programmers, the message of this book is clear: Stay up-to-date and value innovation and talent. Yourdon's strategies can help to meet these goals.

–Steve Apiki is a BYTE consulting editor and senior software developer at Appropriate Solutions, Inc. You can contact him at apiki@apsol.com.

The Rise and Resurrection of the American Programmer
by Edward Yourdon; Prentice Hall, 1996; 318 pages; ISBN 0-13-121831-X; $26.95

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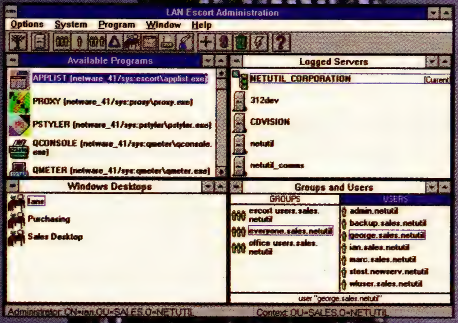

```
APPLIST (netware_41/sys:escort\applist.exe)
PROXY (netware_41/sys:proxy\proxy.exe)
PSTYLER (netware_41/sys:pstyler\pstyler.exe)
QCONSOLE (netware_41/sys:qmeter\qconsole.exe)
QMETER (netware_41/sys:qmeter\qmeter.exe)

NETUTIL_CORPORATION [Current]
312dev
CDVISION
netutil
netutil_comms

Ians
Purchasing
Sales Desktop

escort users.sales.netutil
everyone.sales.netutil
office users.sales.netutil

admin.netutil
backup.sales.netutil
george.sales.netutil
ian.sales.netutil
marc.sales.netutil
stest.newserv.netutil
wluser.sales.netutil

user "george.sales.netutil"
Administrator: CN=ian.OU=SALES.O=NETUTIL    Context: OU=SALES.O=NETUTIL
```

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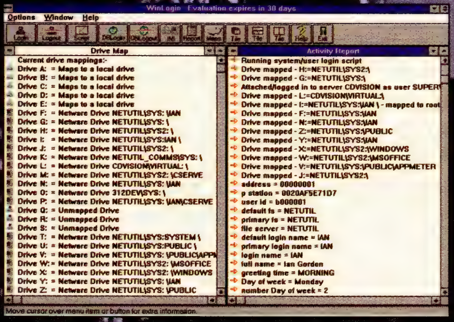


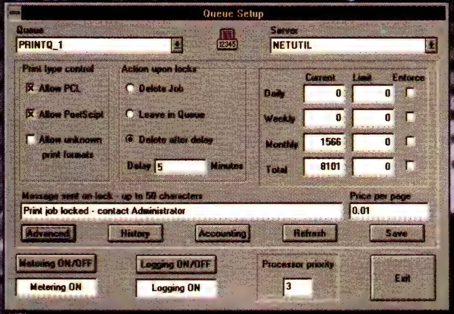
```
Current drive mappings:-
Drive A: = Maps to a local drive
Drive B: = Maps to a local drive
Drive C: = Maps to a local drive
Drive D: = Maps to a local drive
Drive E: = Maps to a local drive
Drive F: = Netware Drive NETUTIL\SYS: \IAN
Drive G: = Netware Drive NETUTIL\SYS: \
Drive H: = Netware Drive NETUTIL\SYS2: \
Drive I: = Netware Drive NETUTIL\SYS:IAN \
Drive J: = Netware Drive NETUTIL\SYS2: \
Drive K: = Netware Drive NETUTIL_COMMS\SYS: \
Drive L: = Netware Drive CDVISION\VIRTUAL: \
Drive M: = Netware Drive NETUTIL\SYS2: \CSERVE
Drive N: = Netware Drive NETUTIL\SYS: \IAN
Drive O: = Netware Drive 312DEV\SYS: \
Drive P: = Netware Drive NETUTIL\SYS: \IAN\CSERVE
Drive Q: = Unmapped Drive
Drive R: = Unmapped Drive
Drive S: = Unmapped Drive
Drive T: = Netware Drive NETUTIL\SYS:SYSTEM \
Drive U: = Netware Drive NETUTIL\SYS:PUBLIC \
Drive V: = Netware Drive NETUTIL\SYS: \PUBLIC\APPM
Drive W: = Netware Drive NETUTIL\SYS2: \MSOFFICE
Drive X: = Netware Drive NETUTIL\SYS2: \WINDOWS
Drive Y: = Netware Drive NETUTIL\SYS: \IAN
Drive Z: = Netware Drive NETUTIL\SYS: \PUBLIC
```

```
Running system/user login script
Drive mapped - H:=NETUTIL\SYS2:\
Drive mapped - G:=NETUTIL\SYS:\
Attached/logged in to server CDVISION as user SUPER
Drive mapped - L:=CDVISION\VIRTUAL:\
Drive mapped - I:=NETUTIL\SYS:\IAN \ - mapped to root
Drive mapped - F:=NETUTIL\SYS:\IAN
Drive mapped - N:=NETUTIL\SYS:\IAN
Drive mapped - Z:=NETUTIL\SYS:\PUBLIC
Drive mapped - Y:=NETUTIL\SYS:\IAN
Drive mapped - X:=NETUTIL\SYS2:\WINDOWS
Drive mapped - W:=NETUTIL\SYS2:\MSOFFICE
Drive mapped - V:=NETUTIL\SYS:\PUBLIC\APPMETER
Drive mapped - J:=NETUTIL\SYS2:\
address = 00000001
p station = 0020AF5E71D7
user id = b000001
default fs = NETUTIL
primary fs = NETUTIL
file server = NETUTIL
default login name = IAN
primary login name = IAN
login name = IAN
full name = Ian Gordon
greeting time = MORNING
Day of week = Monday
number Day of week = 2
```

Move cursor over menu item or button for extra information.

Qmeter

Bringing network printing costs under control



Queue: PRINTQ_1
Server: NETUTIL

Print type control
☒ Allow PCL
☒ Allow PostScipt
☐ Allow unknown print formats

Action upon locks
○ Delete Job
○ Leave in Queue
● Delete after delay
Delay 5 Minutes

	Current	Limit	Enforce
Daily	0	0	☐
Weekly	0	0	☐
Monthly	1566	0	☐
Total	8101	0	☐

Message sent on lock - up to 50 characters: Print job locked - contact Administrator
Price per page: 0.01
Metering ON
Logging ON
Processor priority: 3

Our research shows that despite the remarkable shift from mono to colour printing, reservations still exist in the acceptance of high performance colour printers on networks because of the inability to adequately monitor and control usage. In addition, a large percentage of hard earned budgets will be unnecessarily wasted every year on paper, printer toner and associated consumables.

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How NT 4.0 Merges Win APIs... Right!

When Windows 95 made its debut, Microsoft told programmers the new OS was the path to NT. But developers have learned that various incompatibilities between the two have rendered twists in the road to NT, which may force developers with limited resources to choose between one OS and the other.

Early in the Windows 95 production cycle, Microsoft told developers—in no uncertain terms—that for an application to qualify for a Windows 95 logo, the program also had to run under NT. Microsoft quickly modified its position when it became clear that developers would have to eschew all Win 95-specific functionality.

"It's fair to say that the Windows 95 logo requirements have resulted in some confusion," said Phil Holden, Windows NT Workstation product manager at Microsoft. "We're in the process of updating the logo program now to clarify a lot of these issues."

Currently, to garner a Windows 95 logo, an application must be tested on NT. However, a handful of important Win 95 APIs are not supported under current versions of NT. For example, utilities using the Telephony API (TAPI) will not run under NT 3.51.

In theory at least, a Windows 95- or NT-specific program should degrade gracefully under the other system. But Microsoft provides an out when architectural differences prevent it.

Microsoft's effort to establish congruity between Windows 95 and NT was an attempt to mediate its 32-bit OSes' perceived schizophrenia. Although Microsoft claims that both 95 and NT are 32-bit OSes, the products differ considerably in architecture, performance, and user perception. One example of architectural differences is in NT's and Win 95's driver architectures. "When you build a protocol stack in Win 95, you write to the VxD architecture, whereas if you were to write a stack for NT, you would have to write to NT's driver architecture," says Ted Hess, technical director at FTP Software (Andover, MA),

DataPro Report

HP Takes the Lead in Workstation Performance

In the ever-changing workstation market, Hewlett-Packard has leapfrogged ahead in the category of $25,000-$50,000 midrange Unix RISC machines. The company is also looking to reach users who want a less expensive system: HP has announced a strategy to develop a line of Intel-based Windows NT personal workstations for the low-end desktop market.

For the midrange market, which is still dominated by RISC Unix workstations with sizzling 3-D graphics, HP's Visualize Power Desktops, announced in June, come in two models, both of which use the powerful 64-bit HP PA-8000 processor. HP's Visualize C160 uses the 160-MHz PA-8000, and the C180 uses the 180-MHz version. HP has tripled its performance at similar price levels over its C-Class predecessors, which use HP PA-7200 microprocessors and are upgradable to the new PA-8000 desktops by swapping in a new board.

For the first time in several years, HP has surpassed its competitors, including Digital's fastest Alpha workstation. At 18.7 SPECfp95, the C180 is more than 30 percent faster than Digital's AlphaStation 500/400 (14 SPECfp95), and more than 50 percent faster than SGI's Indigo2/10000 (estimated 12.3 SPECfp95). The C180 comes with HP's new 3-D Visualize-48XP graphics subsystem, which is twice as fast as HP's Visualize-48 (HP's leading graphics subsystem before the June announcement). At around $50,000, the C180 Visualize-48XP is priced similarly to SGI's Indigo2/10000 Maximum Impact but offers graphics performance that's up to three times faster.

The HP C160 is positioned to gain market share in the midrange category. With an entry price of $27,000 (20-inch color display, 64-MB memory, 2-GB disk, 2-D graphics), the C160 offers almost twice the performance of Sun's Ultra 1, with significant performance benefits over Digital and SGI hardware at similar prices (see the table).

The PA-8000 not only gives HP a big boost against its traditional RISC Unix competitors. It reestablishes an almost 3x performance lead over Intel (200-MHz Pentium Pro) in the midrange and high-end technical markets (as indicated by the Pentium Pro's SPECfp95 results of 6.8). For commercial applications, however, Intel's Pentium Pro is within striking distance (as indicated by SPECint95 results of 8.1).

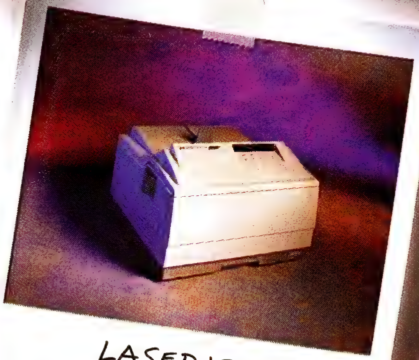
For low-end technical desktops, the Pentium Pro has a serious performance advantage over RISC desktops. The high-performing RISC desktops, like those based on the PA-8000, cannot compete at the low-end price levels. DataPro believes that HP's decision to introduce an Intel-based Windows NT personal workstation will enable HP to compete in this burgeoning market, where SGI and Sun, neither of which supports NT, will lose ground.

– **Peter Lowber** is a senior analyst at DataPro Information Services (Delran, NJ).

Comparing Midrange Workstations

Vendor	HP	Digital	SGI	Sun
Model	C160 Visualize-EG	AlphaStation 500/333	Indigo 2/10000	Ultra 1 Model 170
Processor	PA-8000 160-MHz	Alpha 21164 333-MHz	MIPS R10000 200-MHz	UltraSPARC 167-MHz
SPECint95	10.4	8.8	8.9	6.2
SPECfp95	16.3	11.6	12.3	9.1
Entry price *	$27,000	$25,800	$34,000 (Solid Impact)	$22,995

* Price for 20-inch color display, 64-MB RAM, 2-D graphics when available



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which develops TCP/IP networking applications for intranets. "The differences between the two are nontrivial."

"The current thinking is there will be three Win32 products," Holden said. "For high-power installations, we'll have NT Server and NT Workstation. We'll also provide a smaller, more general-purpose desktop such as Windows 95 for the average user."

The grafting of a Windows 95-style shell onto the upcoming NT 4.0 release will reduce perceived differences among end users. But for developers attempting to target both environments, the differences between the two systems make the goal of one 32-bit world seem elusive. In fact, the changes are significant enough that developers are in some cases targeting only one platform.

Kip McClanahan, a programmer at BMC Software (Houston, TX), favors NT. "Windows NT is much more robust," he says. "And all the features that might make me want to develop exclusively for Windows 95 are right around the corner in the next release of NT."

Charles Petzold, author and Windows developer, disagrees. "Windows 95 has more market share and more interest among end users," he says.

But Petzold and McClanahan agree that although programming for both environments may require additional effort, it should not require parallel development or a two-team approach. "I would focus my efforts on Win 95, then test under NT," Petzold says. "Then, if something doesn't work, just add a work-around to the NT version."

NT 4.0 will support many of the APIs introduced in Windows 95, one notable exception being dynamic Plug and Play support. But Holden maintains that the situation will quickly begin to resolve itself for developers. "Our Windows 95 development team is now working directly with our NT team. Our goal is simultaneous shipment on both platforms."

– Robert L. Hummel

Win32 APIs: Slowly Converging

Product Feature	Windows 95	NT Workstation
System resource capacity	Greatly expanded	Unlimited
Runs MS-DOS applications	Yes	Most
Runs IBM Presentation Manager (through 1.3) and POSIX 1003.1 applications	No	Yes
Multimedia APIs (1)	Yes	Planned for version 4
OpenGL graphics libraries for 3-D graphics	Future release	Yes
Win 95 user interface	Yes	Planned for version 4
Plug and Play	Yes	Static in version 4; yes in future release
System Policies (2)	Yes	Planned for version 4
Built-in Universal Inbox providing e-mail and fax	Yes	Planned for version 4
Built-in Microsoft Network client software	Yes	Future release
Preemptive multitasking for Win16 applications	No	Yes
System completely protected from errant Win16 and Win32 applications	No	Yes
NTFS (3)	No	Yes
Automatic recovery from system failure	No	Yes
Runs MS-DOS device drivers	Yes	No
Runs Win16 device drivers	Yes	No
Minimum recommended RAM	8 MB	12 MB
Typical disk-space requirement	40 MB	90 MB
Runs on PowerPC, Mips, Alpha RISC systems	No	Yes

(1) DibEngine, Direct Draw, DirectSound, Direct Input, Reality Lab graphics libraries

(2) to provide centralized control over desktop configuration

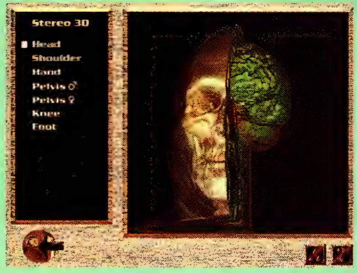
(3) File system provides complete protection of files on stand-alone system (files, folders, and applications can be made invisible to specific users).

cd-rom review

Virtual Dissection

Several years ago, medical researchers at the University of Colorado Health Sciences Center, working in conjunction with the U.S. National Library of Medicine, started the Visible Human Project. The goals of the project were to turn a male and a female cadaver into high-resolution digital images and models, then make part of this research available to the public.

The original data from the project amounted to more than 50 gigabytes of digital images. The unprocessed data includes 6000 color photographs of cross-sectional anatomy as well as computer tomography and magnetic resonance images. The Digital Humans CD-ROM consists of a small sample of the data but gives a very educational and realistic glimpse into 3-D anatomy.



Thousands of cross-sectional color photographs were digitally layered to create a 3-D model of the skin and underlying tissue. This color 3-D model was then fused with a skeleton model reconstructed from the computer tomography images. You can interactively rotate and view the digital humans from the front or side or horizontally. When viewing with (enclosed) 3-D glasses, you see a stereoscopic view of human anatomy that comes close to what medical students see in a dissection room. One section of the program lets you rotate the head in three dimensions and see how the brain sits relative to the skull.

Additional applications are expected to come from the Visible Human Project. Researchers say they are working on virtual surgery on simulated combat wounds, as well as adding models of children and of people who died of different diseases.

–Rich Friedman

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Circle 80 on Inquiry Card (RESELLERS: 81).

Blasts from the Past

15 Years ago in BYTE

Editor in chief Chris Morgan wrote about a rumored PC, the first expected from IBM. While others fretted that IBM's entry would dominate the nascent PC business, Morgan noted: "Good large companies don't always supplant good small companies" and that "Competition is growing from all sides."

10 Years ago in BYTE

Five years after Morgan's editorial, many BYTE reviews were of so-called IBM PC clones. In addition to the Commodore 128, we evaluated ITT's XTRA XP, an AT-compatible, and Microshop Computer Products' IBM PC XT-compatible. The XTRA XP came with a 20-MB hard drive and 512 KB of RAM, a 6-MHz 286, and other hardware for $4595. That issue's Microbytes section reported on Commodore's Sidecar, a PC-compatibility add-on box for the Amiga that was displayed at Comdex. Micro Interfaces advertised its Run/CPM program that let a PC run the thousands of programs written for the CP/M-80 operating system.

5 Years ago in BYTE

By then we were preparing to upgrade to MS-DOS 5.0. Jon Udell wrote that although this version was not the high-tech DOS that we'd hoped for, the new version had improved memory management, a task swapper, and other features that made it a success. In a section on wide-area networking, author Sharon Fisher noted that the Internet is spreading from its research roots into the commercial and education sectors. Now BYTE editors wrestle with the question: Can you run your business on the Internet?

How Computers Will Solve the Health Care Crisis

Haruhiko Asada, professor at MIT and director of the Total Home Automation and Health Care/Elder Care Consortium, describes how computers, robots, and software will improve home health care.

BYTE: The population in most countries is getting older. Could you describe the ramifications?

Asada: There are different statistics, but it's fair to say that one person out of five will be 65 years or older by the year 2010 in the U.S. By the year 2030, in both Germany and Japan, 24 percent, and in the U.S., 17 percent, will be over the age of 65. The bottom line is we can't continue the current practice of elder care. We're going to have too many elderly and too few younger people who can take care of them, to do things like move the patients out of bed.

BYTE: How can computers and networks help?

Asada: We start with very simple stuff, just a home computer and a small camera on top of it, in the individual patient's home for remote teleconferencing. We hook it up to the Internet through ISDN. This allows healthcare professionals to visit patients' homes virtually.

BYTE: What about bedridden patients who need assistance?

Asada: You can't bring a sophisticated system into the patient's home abruptly. The first step, Level One, is the Internet connection. Once the patient accepts that, we go to Level Two, where we provide health-monitoring sensors. All these sensors are hooked up to the Internet so doctors and nurses can monitor health status remotely. Once the patients accept that, we move to Level Three, where we provide physical-assistance devices, such as for bedridden patients.

BYTE: Could you tell us about these new devices you're developing?

Asada: We are in the process of developing a hybrid wheelchair/bed system where the patient doesn't have to move out of the bed. The bed itself can move in an omnidirectional way .

BYTE: What are some of the other technical developments you are working on?

Asada: There are going to be quite a few new devices to monitor patients' health status. We are developing, under this consortium, extremely small sensors that can be worn comfortably by the patients, called MEMS, or micro electromechanical sensors. And we can miniaturize those sensors drastically, so you can embed sensors in clothing. We are talking about instrumented pajamas, so you can monitor your heart activity or blood pressure very comfortably.

BYTE: What happens in Level 4?

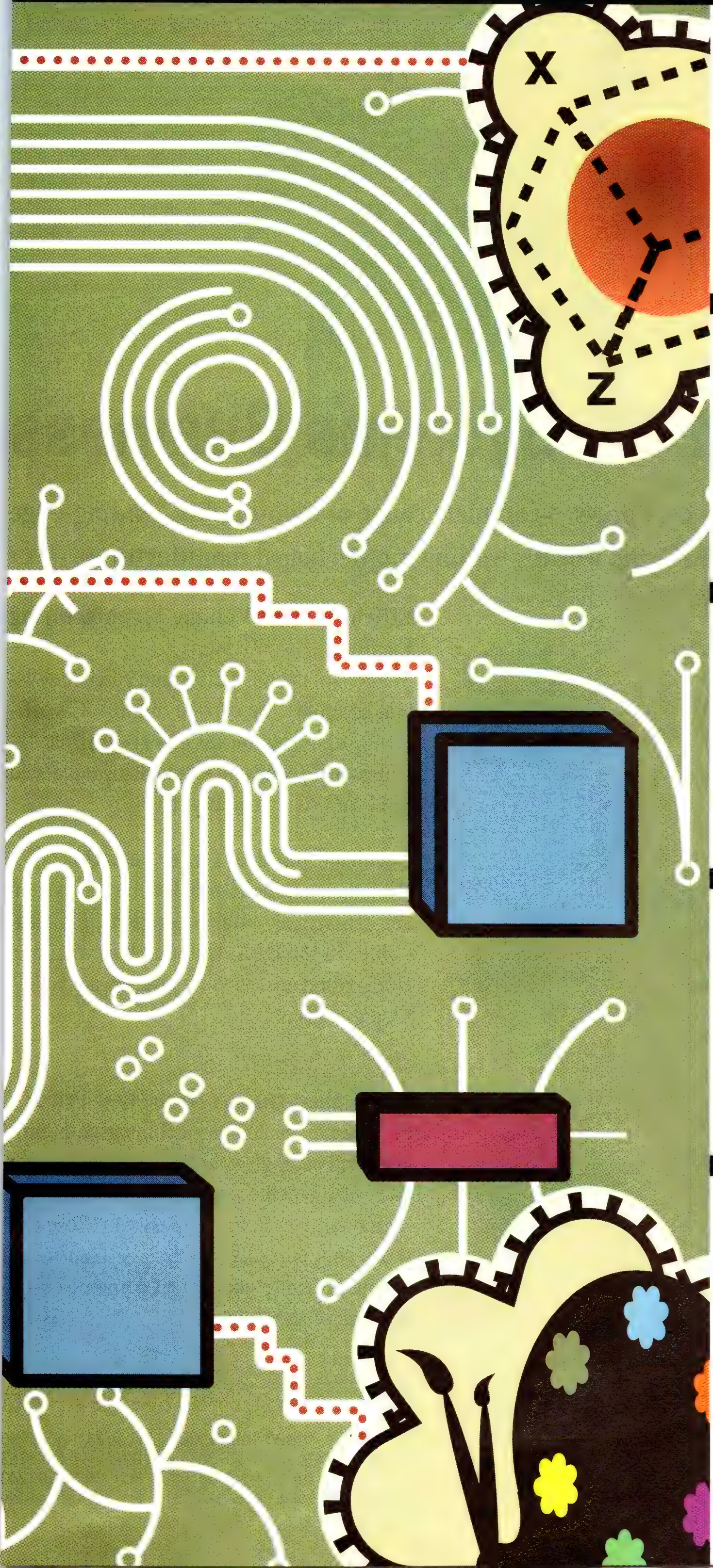
Asada: Level Four is general maintenance. We have to provide services such as cleaning a room. But a home is a very unstructured environment. So the first step is to make the complete inventory. We are using invisible bar codes to identify all the items in the home.

BYTE: So this will allow robots that are cleaning up to identify objects?

Asada: Exactly. A robot cleaning up the floor must know what's on the floor and how to avoid it. For example, a robot will identify a wine glass and know it has to handle the glass carefully. We are building some home robots, what we call Robo-Maid, having two arms and an omnidirectional vehicle. Robo-Maid knows all items within the house. So if the bedridden patient wants to have some meals, Robo-Maid opens up a refrigerator that has its own inventory.

BYTE EXTRA

International



Bug-Infested Software

Many European developers admit to shipping buggy code. See this month's Bits. Page 40IS 3

Worldwide Mobile Phones

The cellular-satellite phone will someday keep you connected anywhere. Page 40IS 6

Teamwork on the Net

Adaptive multimedia applications will aid collaborative work. Page 40IS 9

USB Motherboards

Taiwanese manufacturers are embracing the Universal Serial Bus. Page 40IS 13

Searching Software

MyDesk can search original documents without relying on OCR files. Page 40IS 18

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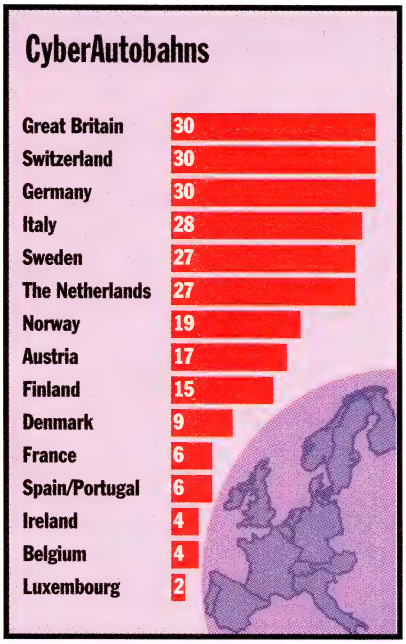
How to Choose an ISP in Europe

A Swiss study reveals the state of Europe's Internet infrastructure.

How did you choose your local Internet service provider (ISP)? If you live in a rural area, there might be just one ISP offering local access. If you live in one of Europe's cities, however, you will very likely find several offers with different prices and access rates. In a major city such as Frankfurt, for example, you will find about 10 ISPs, and in Zurich more than 15 of them.



Number of ISPs in Europe.

But it's not just price that makes for a quality ISP. Especially for businesses, it's important to know which routes the data packets travel. In other words, you need to understand the regional Internet infrastructure to which your ISP connects.

A new study called "Featuring the European Internet: CyberRoadMaps" charts how Europe's nearly 300 ISPs are interconnected and how they link to the backbone providers. The report was written by EuroInternet, a consulting company based in Bern, Switzerland, and the European Electronic Messaging Association. EuroInternet also measured the performance of ISPs by counting the number of times packets had to be shunted from one network to another until they found their destination and the actual time it took for a packet to complete a return journey. Both figures are shown in the "CyberRoadMaps" report.

The results were confirmed by more than 40 percent of the ISPs. However, you have to keep in mind that the journey times are nevertheless only approximate because of the variable data traffic on the Internet, says Jim Romaguera of EuroInternet. You can check out CyberRoadMaps at www.marktplatz.ch/eurointernet. This month EuroInternet is expected to publish CyberRoadMaps for the U.S., Japan, and Australia.

–Valerie Thompson

Software Bugs

The truth hurts. "Many software development organizations pay lip service to quality—shipping untested software when deadline pressures dictate." That's the not-so-surprising conclusion of a study, published by CenterLine Software (Cambridge, MA), that surveyed more than 300 software organizations in Europe.

What's more astonishing is that 57 percent of the developers admitted that their organizations had knowingly shipped software with bugs, and a staggering 76 percent of developers believe users are "programmed" to accept software flaws, expecting they'll be addressed in a later release.

Asked about what kind of development environments produced the most bugs, 52 percent of respondents said multiplatform development. Other bug-producing culprits include rapid application development (RAD) and shared development. However, 74 percent of developers are significantly more concerned about software quality than they were five years ago, according to the survey.

We're not sure if this is good news or bad news. **–Rainer Mauth**

Save Energy: Shut Down Your LAN

Companies can reduce the power consumption of their LANs by more than 50 percent. How? By using state-of-the-art energy-optimized devices and shutting down their networks over night. That's the result of a survey published recently by the Swiss Federal Office of Energy. The study, entitled "Efficient Energy Management in Computer and Communications Networks," also says that computer and communications equipment eats up about 1.6 percent (772 GWh) of the total energy consumed in Switzerland.

Reacting to the study, Getatron (Amriswil, Switzerland) developed an energy manager for small and midsize LANs. The device, expected to ship later this year, can be programmed to shut down the LAN, and all components, after regular working hours. Before shutdown, the system warns late workers, who can keep the LAN powered up by just pressing a button on the energy manager.

Software Sales Booming in Asia

But software piracy is still a major problem.

Sales of PC software reached $1.14 billion in Asia last year, a staggering 57 percent growth rate over 1994 (the latest figures available), says the Software Publishers Association. But software piracy remains a major problem in many Asian countries, where the total losses in China alone were estimated to range from $1 billion to $2 billion last year, depending on the analyst or trade organization you talk to.

Both of these trends will bless—and haunt—software companies in 1996 and perhaps beyond. "I don't see a big improvement in China this year," says a spokeswoman for the Business Software Alliance, adding that software piracy is also running rampant in other Asian countries, especially Indonesia, the Philippines, Thailand, and others.

Still, China is perhaps the biggest concern among U.S. software companies, in spite of an intellectual property agreement signed between Washington and Beijing earlier this year. More than 20 outfits in China illegally produce about 100 million CD-ROM discs per year, 20 times the legitimate domestic demand, analysts say.

But enforcement is difficult, if not impossible: Many illegal CD-ROM houses are reportedly owned and operated by China's military, possibly the nation's strongest political faction, according to many sources. This has put Washington and Beijing on a collision course, including a possible trade war.

Ironically, though, China's PC software industry is one of the fastest-growing in Asia. Although it is coming from a smaller base, China's PC software industry hit $4.6 million last year, a 189 percent growth rate over 1994, says the SPA. In fact, Asia's entire software industry is booming. Microsoft and others reported record growth in the region last year. This year? SPA officials declined to project sales figures for 1996, but many software companies indicate they are bullish.

"We're still seeing growth in all sectors of our business," says Christopher Slade, vice president of marketing for Oracle's Asia/Pacific operation, based in Singapore. "We've seen a 50 percent growth per year in Asia-Pacific over the last few years. Applications are growing by 100 percent per year. We don't see a slowdown in the region this year."

In general, the software industry, including PC- and non-PC-based concerns, will continue to grow in the region, especially as several Asian nations begin to deregulate their telecommunications and related industries, Slade says. "There's also been a swing among Asian companies from building their own software products to buying packaged software," he adds.

Japan remains the largest PC software market in Asia, due in part to the explosion in PC sales there. Software sales in Japan were $757.8 million in 1995, up 45 percent over 1994, the SPA says.

The next largest market was Australia/New Zealand. Sales in those two countries hit $189 million last year, 21 percent growth from 1994, according to the SPA. Asia's four Tigers—Hong Kong, South Korea, Taiwan, and Singapore—also were robust markets for PC software.

Thailand was the fastest-growing market in Asia. Its PC software industry reached $11.6 million last year, a 277 percent growth rate over 1994, according to the SPA's figures.

–Mark LaPedus

Agent Browses Web for You

New JavaScript agent technology will search the Web and conduct transactions on your behalf.

With thousands of new strands being added daily to the tangled World Wide Web, it's becoming increasingly tedious to find the information you want. Intelligent agent software being developed by AgentSoft will locate the information you're looking for and can act on it as well.

"The term 'intelligent agent' has been used in many different ways," says AgentSoft chairman Dr. Jeffrey Rosenschein, who also leads the Distributed Artificial Intelligence group at Jerusalem's Hebrew University. "For example, it is used by Microsoft to describe their code modules that back up your hard disk at a certain time of night." However, AgentSoft, a new subsidiary of Accent Software International, has something far cleverer in mind: software that browses for you, incorporating expert-system technology and the AI techniques of learning and planning.

AgentSoft's agents will be able to run unattended or they can act as run-time browsing assistants for Internet or intranet users. "The key things are sophistication, power, real intelligence," according to Rosenschein.

The intelligent agent that AgentSoft is developing will be implemented in Java and JavaScript, making it platform-independent. And it will be embedded natively in any Java-enabled Web browser, such as Netscape Navigator 2.0, so that all its interactions occur through the facilities provided by the browser. To the user, the intelligent agent will simply be an extension of the Web browser.

Let's say you want to book a flight on a particular day and within a certain price range. To trawl through all the relevant Internet sites is extremely time consuming, so you call in the intelligent agent. Given your date, time, location, and price specifications, as well as other parameters such as flight route, off the agent goes without the need for further intervention. The agent will come back later with a list of, say, all flights to Rome via Paris on a Wednesday that cost less than $700.

AgentSoft has chosen to make its agent client-based, so it runs on the user's machine rather than traveling to the source of information and running there. The main benefit of this approach is better privacy for the user with regard to sensitive information that the agent may need to perform certain tasks. However, the agents are transportable and can run on other people's machines if no sensitive information is involved, which enables remote executing of agents. Agent-to-agent interactions are also possible. AgentSoft expects to launch its product by the fall.

–Tania Hershman

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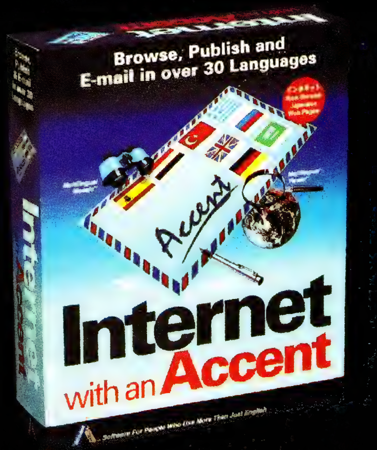

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Global Mobile Communications

Near the end of the century, four new satellite services will let you stay connected anywhere in the world.

By Elke Gronert

The Global System for Mobile Communications (GSM) phone has become a commodity item. More and more professionals in Western Europe connect to corporate databases via GSM data cards while they are on the road. However, there are still rural areas without GSM cells, especially in Eastern Europe and developing countries. Also, in areas with low population densities, mobile workers will not be able to benefit from terrestrial cellular systems for several years to come. The number of people outside GSM coverage is very large.

ILLUSTRATION: JACK MORTENSBAK © 1996

Why not fill this gap with mobile phone and data services delivered via satellite? This is the thinking behind satellite-based mobile-communications systems that will become operational in two years. Global phone and data access that's independent from terrestrial or radio-link networks would be ideal. But it will not be inexpensive.

Dual-Mode Phones

Before the turn of the century, several communications systems will combine today's cellular-radio transmission systems with mobile satellite services. The main players in this global market will be Globalstar, ICO, Iridium, and Odyssey. All four have announced their rollout plans and are close to launching their first satellites. Globalstar and Iridium expect to have services available in 1998. ICO and Odyssey will follow a year later and should be fully up to speed in the year 2000.

Established satellite hardware vendors have intensified their R&D efforts to produce new devices for the coming mobile satellite services. The technical hurdles they have to overcome are the design of digital signal processors (DSPs) for the GHz band, implementation of high-frequency antennas in PC Cards, and the design of dual-mode—cellular and satellite—mobile phones. It will be approximately two years before we begin to see prototypes of products. Shipping products will not be available until they can be tested with operational satellites.

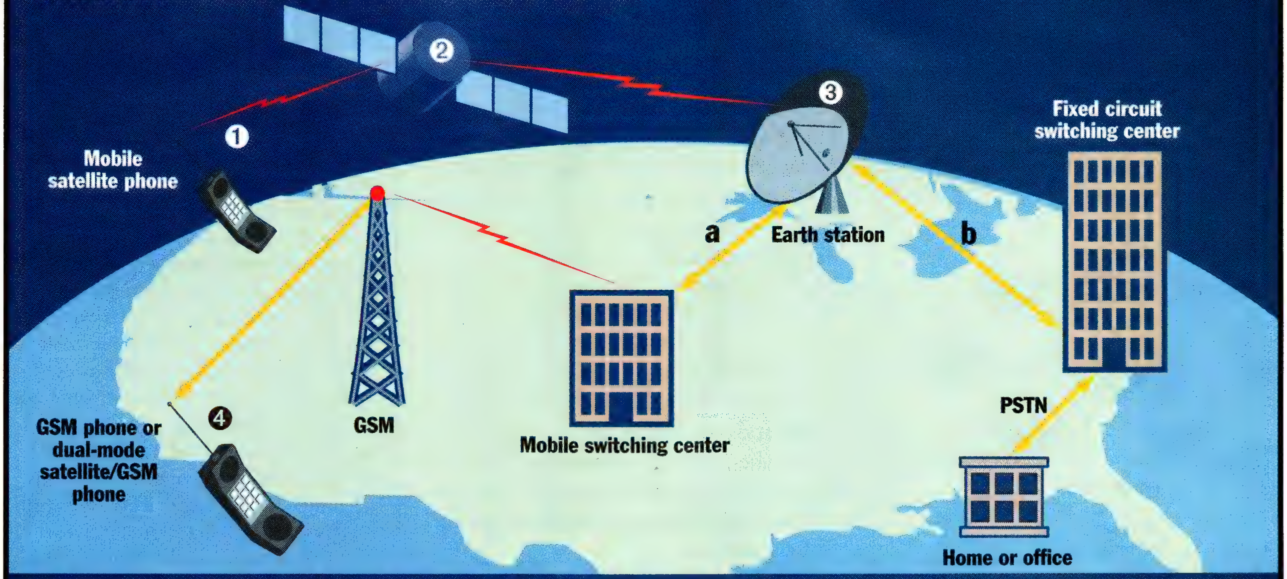
The new satellite phones will weigh only a fraction of today's portable satellite phones; the present-day Inmarsat M satellite system, for example, weighs about 9 kilograms. Though some devices such as Nera's (Billingstad, Norway) have the antenna in the lid of the phone's briefcase, most need a massive dish as an external antenna. By contrast, the hand-held phones of Globalstar, ICO, and Iridium will eventually weigh not much more than today's GSM phones, about 400 grams.

Commercial communications satellites with specifications for portable equipment have been around for more than 15 years. The Inmarsat satellite system, for example, was launched in 1979. The first service, called Inmarsat A, was offered in 1982. It was designed for maritime use only. We then saw the following services: Inmarsat C, for data and telex transmission; Inmarsat B, a digital system for voice, fax and data; and Inmarsat M, for voice and low-speed data.

However, portable is not mobile. To operate one of today's Inmarsat M systems, you have to locate the nearest satellite with map and compass and adjust the antenna toward the corresponding direction. While cellular communications systems were first aimed at voice communications, even the oldest Inmarsat services provided voice, data, and fax transmission.

A new—though unannounced—version of Inmarsat M

Satellite Phones Link to Cellular and Wire Networks



❶ Setting up a call with a mobile satellite phone will be as easy as using today's cellular phones. Huge dish antennas will not be required.

❷ Satellites can handle up to 48 beams each, with a capacity of 200 simultaneous calls. If a subscriber moves out of a beam of one satellite, an adjacent satellite has to take over the call.

❸ Earth stations act as gateways to cellular and fixed-circuit networks.

a) The mobile switching center routes calls from the earth station to the cellular infrastructure (and vice versa).

b) Most calls will be directed to the Public Switched Telephone Network (PSTN). Intercontinental calls will be routed through the ground network of earth stations.

❹ Users of dual-mode mobile satellite phones will be able to choose between satellite or cellular connections. In areas without a cellular infrastructure, satellite links will still be available.

By the year 2000, mobile satellite services will provide global communications. Earth stations will act as gateways to the regional and national PSTN and cellular networks.

promises to reduce equipment weight. Industry observers expect to see the service, code-named Inmarsat Mini-M, by the end of the year. It will enable usage of portable phones weighing about 2.5 kg, which is widely seen as a compromise between the heavy Inmarsat M terminals and the handy ICO terminals coming by the end of the century. Products for this service were shown at this year's CeBIT, with a suggested price of DM 7000 to 10,000.

Globalstar, ICO (initially called Inmarsat P), Iridium, and Odyssey are full digital services, which will provide mobile personal communications at a bandwidth of 9.6 Kbps. However, Globalstar and ICO will also introduce a combination of cellular and satellite services: dual-mode handsets. The first dual-mode phones for ICO will likely enter the market in 1999. They will look like today's GSM phones and should cost about $1000. In urban areas, these phones will work with GSM. In areas where GSM is not available, you will be able to switch to the satellite service with just a keystroke.

Joint Ventures

The design of dual-mode phones requires a good understanding of satellite and cellular technologies. Nera, one of the market leaders in Inmarsat devices and base stations, therefore signed a contract with Ericsson and NEC for the codevelopment of the new systems. While Nera has a great deal of experience in satellite technology, Ericsson will add the GSM expertise and NEC will deliver the antennas.

Iridium will be the first mobile system on the market. However, initially, it will be bigger and heavier than, for example, today's GSM phones, and it will not be combined with cellular technology.

Globalstar and Odyssey will cover mainly the U.S. market with dual-mode services. Orbitel Mobile Communications (Basingstoke, U.K.), for example, announced early this year that it will develop Globalstar handsets using the code division multiple access (CDMA) cellular technology. The retail price for these devices will be about $800 in 1998.

Advanced Satellite Networks

These advanced satellite networks communicate over two different frequency bands, one for communication between the satellites, and one for the link between users and the satellite. Iridium, for example, will deploy the L-Band (1500 GHz) spectrum for the subscriber link and the Ka-Band (1600 GHz) for communication between the satellites. ICO is set to operate at

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1285 GHz for the satellite-to-earth link and at 2015 GHz for communication between the satellites.

Beams of Coverage

Satellite "beams" are the communications links to the earth. They are stationary relative to the satellite, but because the satellites circle the earth several times a day and subscribers may move out of one beam during a call, the satellite systems need to route the call from one beam to another. In a similar way, cellular systems automatically route the call from one cell to the next during the movement of a subscriber. Satellite systems automatically hand over calls to the next available beam when subscribers leave the reach of the initial beam. But the satellite systems will also change beams once a minute for security reasons.

The L-Band, for instance, will have up to 48 independent beams, covering an area of up to 600 square kilometers, each with a capacity of 200 simultaneous calls. Though beams are independent, they can also overlap in coverage.

Huge Investments

To transfer satellite voice and data traffic into the fixed public network, satellite systems need numerous earth stations that act as gateways. Iridium, for example, plans to have 20 of these earth stations during the first phase of implementation. They will operate satellite dishes of more than 3 meters in diameter.

The investments in mobile satellite systems are enormous sums of money. ICO expects to invest about $2.6 billion for 12 satellites, Globalstar reckons it will spend $1.9 billion to launch 56 satellites, and Iridium expects to spend $3.4 billion for 66 satellites. Despite these massive investments, however, some experts believe that the announced rollout plans and time scales are very aggressive and perhaps unrealistic.

High-Speed Data Over Satellite

In the first phase, mobile satellite communications systems will deliver primarily phone services. Eventually, data services at 9.6 Kbps will follow. However, mobile data services are far away. Today, to transfer data via satellite from one PC directly to another, the very small aperture terminals (VSAT) system provides transfer speeds of up to 2 Mbps. VSAT allows international retail chains to communicate with all global subsidiaries.

DirecPC, a VSAT service offered by Hughes Olivetti Telecom (HOT), requires an ISA bus adapter card, a 24-inch satellite dish, and a Windows software kit. According to HOT, Internet access at 400 Kbps will be available later in the year.

A new satellite service announced by Comsat World Systems (Bethesda, MD) in April will transfer data at asynchronous transfer mode (ATM) speeds over the Intelsat network. The company says it developed an ATM link accelerator deployed at the earth station or a customer's premise to enhance the performance of ATM via satellite to the quality of fiber. Comsat expects to sell to multinational corporations that need to communicate to far-off places but do not have fiber connections. The Comsat service will start in the U.S. in September.

WHERE TO FIND

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A Question of Security

More than money is involved, of course, in setting up large international projects. In war zones, where satellite communications are critical and often the only link to the outside world, governments will not look favorably on telecommunications equipment carried around by foreigners. This fact alone may inhibit the spread of mobile satellite systems. Additionally, satellite equipment has to be in harmony with national telecommunications laws. An unfettered global communications service has more than just technical problems to overcome. **B**

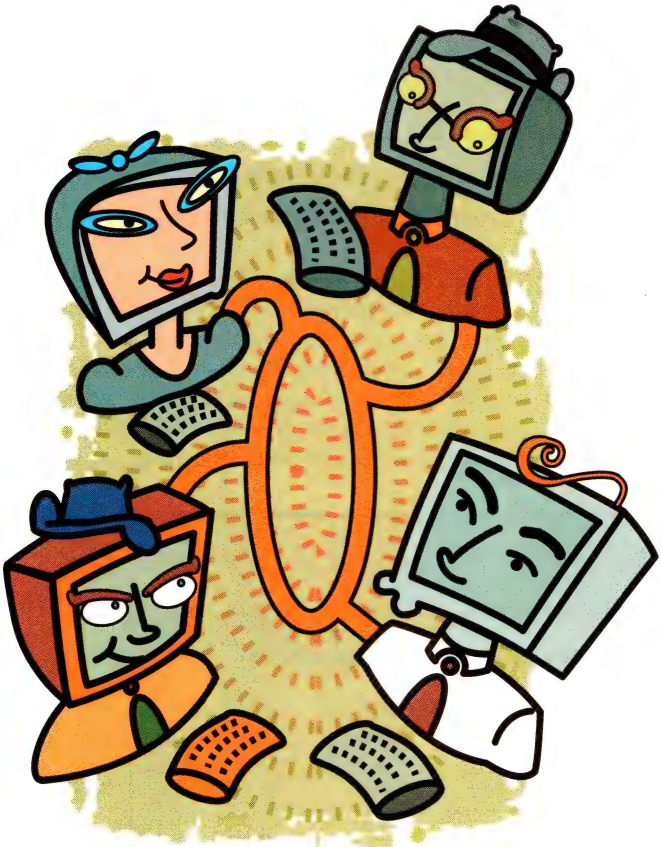
Elke Gronert is a telecommunications journalist in Munich, Germany. You can reach her by sending e-mail to **editors@bix.com**.

Teamwork on the Net

Adaptive multimedia applications will aid collaborative work.

By Bob Emmerson and David Greetham

Of the 44 million computers that will sit on Europe's corporate desktops in 1998, 71 percent will be connected to a LAN. Most network managers think of LANs as coherent topologies and regard WANs as links between islands of information. But what's really needed for computer-supported collaborative work is a seamless environment for multimedia applications, where terms like *LANs* and *WANs* are irrelevant.



Mobile professionals and corporate workers in far-flung locations need more bandwidth and less-expensive services to work effectively together. The public WAN infrastructure is circuit-switched and employs synchronous communications. LANs, meanwhile, employ a packet-switched infrastructure, so their communications are asynchronous. These services are all fine in their own way, but they don't work well together.

However, they all work with the Internet. Access is ubiquitous, easy, and affordable, so the Net has become an effective integrator—a common denominator that's ideal for e-mail and file transfers. Therefore, all the Net needs to become the ideal platform for collaborative work is a higher quality of service (QoS)—a guaranteed bandwidth for multimedia applications and minimal latency, or delay—which is critical for voice communications.

But the Net currently comes up short on bandwidth. And packet-switching latency is a major issue.

Shared Workspaces

The European research community, one of the early adopters of the Net, is currently pioneering many new technologies, applications, and systems that enhance collaboration. GMD, the German National Research Centre for Information Technology (Sankt Augustin, Germany), for example, has implemented the Basic Support for Cooperative Work (BSCW) shared workspace system on its Web server (located at http://bscw.gmd.de).

BSCW, which works with a regular Web browser, includes so-called awareness services, where icons attached to objects indicate events that have occurred with regard to the objects. Thus, team members immediately recognize if an object is new, if it's been read recently, or if a link has been renamed.

Each member of a workspace has a personal list of all events in that workspace, so everyone is always aware of other members' activities. The BSCW site also offers public access for creating your own shared workspaces.

GMD says it will eventually support an e-mail interface that allows users to send e-mail messages whenever a certain event occurs. Thus, users will automatically get an update of the activities within the workspace even when they're not on-line.

Real-Time Collaboration

Packet switching is ideal for data communications where latency is not an issue. It's also efficient, since the communications link can handle different types of traffic coming from any number of parties. With packet switching, links can work to their maximum capacity, but the real-time behavior varies widely. Therefore, because of its packet-switched nature, the Net is currently a poor communications medium for voice traffic, since it wasn't designed to handle isochronous information.

Bandwidth is also a key issue for real-time collaboration on the Net. The replacement for the current IP protocol is being addressed by the Internet Engineering Task Force (IETF). IP version 6 (IPv6), the next generation of Net protocols, has been designed to run on high-performance networks and still be efficient on wireless and other low-bandwidth connections.

The benefits that IPv6 will bring include more efficient addressing, faster routing and delivery mechanisms, multimedia enhancements, and the potential to make the Net more secure.

continued

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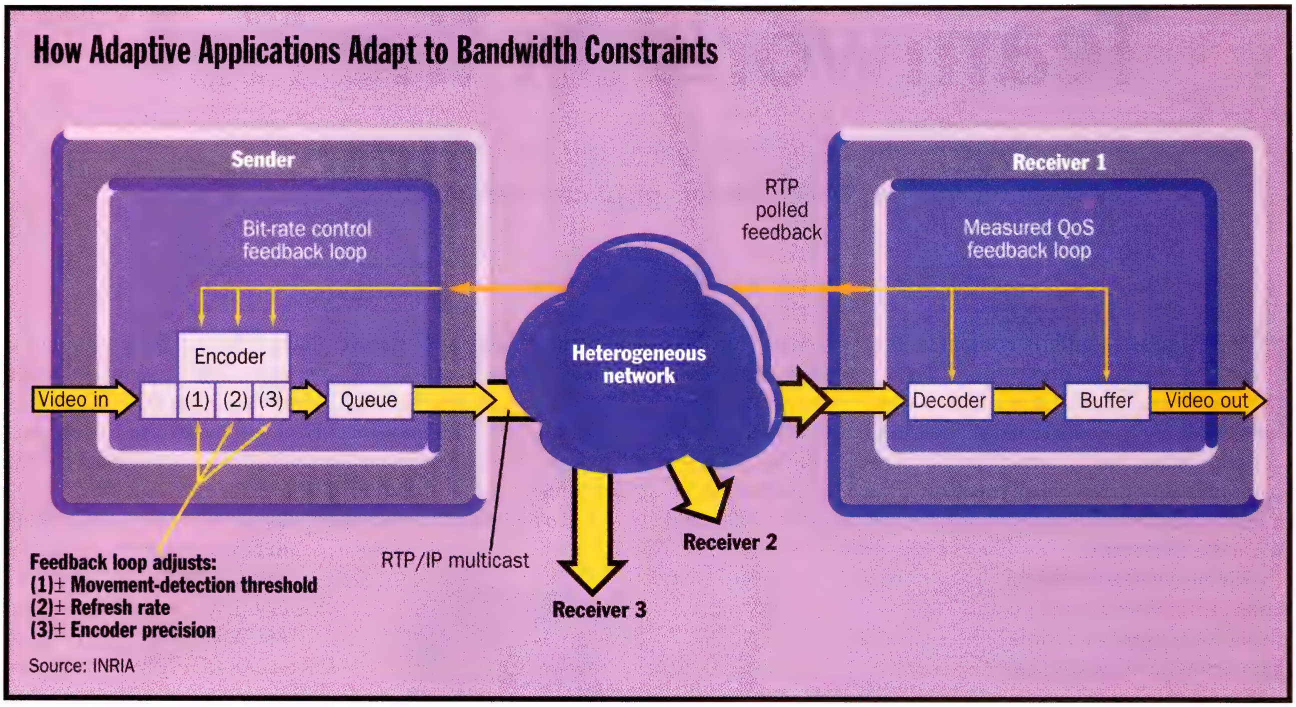
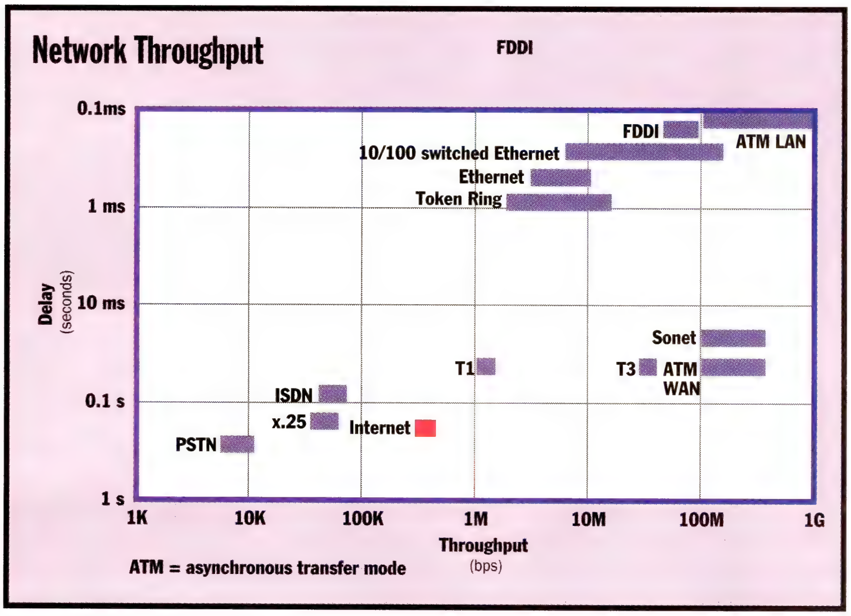


Source: INRIA

Adaptive applications can adjust their quality of service (QoS) to suit the prevailing network conditions.

Deployment has already started, but about two more years are needed before IPv6 becomes the de facto stack for desktop machines.

IPv6 addresses the latency issue by enabling prioritization. For example, a video bit stream can be split into several channels that have progressively higher definition. When congestion occurs, the higher-definition channels are dropped, thereby decreasing the bandwidth requirement and allowing a lower-resolution image to get through to the receiver. This technique, which is known as *hierarchical encoding*, is particularly suitable for broadcasting.



Today's Internet was not designed to deliver real-time applications. (Source: Bay Networks)

The IETF is also working on the Reservation Setup Protocol, or RSVP, which operates above the IP layer. RSVP aims at receiver-initiated allocation of resources to reserve bandwidth over the link and thereby simulate a circuit-switched connection. This network-control protocol will allow Net applications to obtain a higher QoS for their data flows.

When an application in a host requests a specific QoS, RSVP is used to pass the request to each router along the paths of the data stream. The protocol enables multicasting (i.e., one-to-many links) and is receiver-oriented. To efficiently handle heterogeneous receivers and dynamic group memberships, RSVP makes receivers responsible for requesting resource reservations. Although it's a potentially expensive solution, it's an excellent way of minimizing the problem of latency, which is a particular problem for voice transmission.

Data Compression

Circuit-switched voice signals are sampled eight times per second, and each sample has 8 bits of data; thus, high-quality speech requires a bandwidth of 64 Kbps. Compression techniques can reduce the data-throughput rate and still give acceptable quality, but they all steal cycles from the CPU.

Video compression demands less timing accuracy than audio, since large portions of a picture, such as the background, don't change from frame to frame. However, MPEG is not a solution for the Net, since this codec requires fixed bandwidth (see "Toss your TV," February BYTE).

In 1992 and 1993, the French research organization Institut National de Recherche en Informatique et en Automatique, or INRIA, tested multimedia compression algorithms for the Net that are now incorporated into the IETF's Real-Time Protocol (RTP). RTP, which specifies how to adaptively encode audio and video information, is increasingly being used on the Net's multicast backbone, MBone (see the text box "The Internet's Multicast Backbone" at right). And INRIA's Rodeo Group implemented RTP in its Internet Videoconferencing System (IVS), which is also based on MBone.

Adaptive Applications

INRIA's research indicates that multimedia applications over the Net work best if they are able to adapt to the varying bandwidth of this heterogeneous network. Adaptive applications reduce the amount of data transmitted during periods of congestion; this results in either a lower-quality transmission (known as *throughput adaptation*) or a reduced frame frequency (known as *delay adaptation*). These applications detect delays and then establish a correct-size "playback" buffer on the recipient's system.

Throughput adaptation can be achieved using hierarchical encoding or variable compression ratios. The former is attractive for large broadcast applications, where closed loop control would be impractical. The latter has been implemented by INRIA in its IVS system.

Senders constantly poll the receivers being used in a multicast group to estimate the quality of reception and then compute the available bandwidth and set the compression ratio accordingly. As a result, a high-quality signal is transmitted when the network link is lightly loaded, and a poorer-quality signal is sent when it's crowded.

Maximum efficiency of adaptive applications (a relative parameter) does not depend on network resources (an absolute parameter). This adaptation concept was first implemented for video signals, and INRIA has now ported the technology to audio signals. The system also ensures good "cyberspace citizen" behavior, since feedback control prevents video applications from swamping the Net's resources.

The polling process is part of RTP. Therefore, any system that uses this protocol, such as the IVS system, becomes adaptive. This means that the application

The Internet's Multicast Backbone

The standard transmission service on the Internet is point-to-point, or unicast, service. To accommodate multimedia for collaborative work, you need a multicast (i.e., one-to-many) service. Therefore, the Internet Engineering Task Force (IETF) adopted the IP Multicast Protocol (RFC 1112) in March 1992 for building multicast applications on the Net. It runs on the virtual Internet backbone for multicast IP, known as MBone, which is an international test-bed for multicast applications.

IP multicast–based routing helps distributed applications achieve time-critical communications over wide-area IP networks through a highly threaded communications model. The IP multicast routers, which are commonly called mrouters, take the responsibility for distributing and replicating the multicast data stream to its destinations. However, broadcasting is not used on most parts of today's Net, because too much bandwidth is consumed and individual subnets are reached whether they're interested or not.

For more information on MBone, see www.best.com/prince/techinfo/mbone.html or www.cl.cam.ac.uk/mbone.

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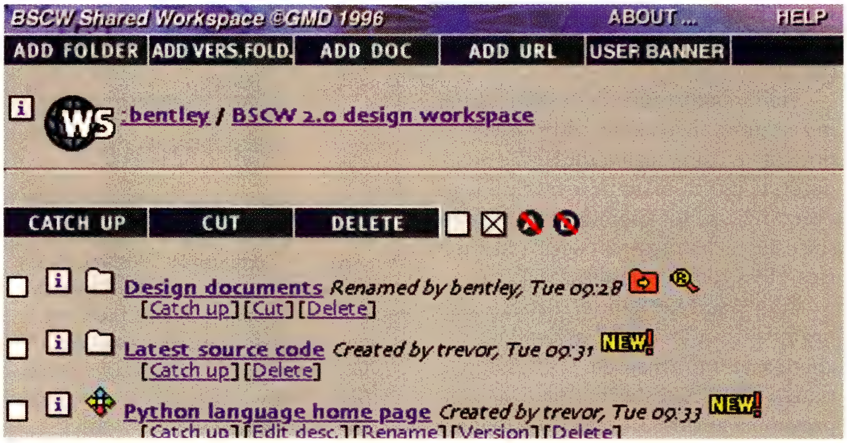
makes optimum use of network resources and no hardware upgrades are needed.

The quality of audio and video over the Net is quite restrictive; however, new protocols, the MBone, and adaptive applications point the way toward the QoS we're going to get in a few years. But don't expect the multimedia equivalent of a free lunch. Clients will require an ISDN connection in order to get optimal video quality.

Until the Net is upgraded to better handle multimedia applications and there is smoother integration among today's LANs and WANs, the optimum solution would seem to be a system that runs across all main media types (e.g., LANs, Public Switched Telephone Network [PSTN], ISDN, and TCP/IP). Cybertec's (Newton Abbot, U.K.) V-COM software meets these requirements.

V-COM has a software codec, so transmission speed depends on the PC, the modem, and, in the case of the Net, the time of day (because of the variable delay). However, Cybertec says that V-COM brings 24 color frames per second on an analog line using a 28.8-Kbps modem and approximately 4 to 5 fps over the Net. It also allows interactive, real-time application sharing and whiteboarding. Expect to see more all-in-one videoconferencing solutions of this kind hitting the market fairly soon.



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Shared workspaces, such as BSCW, let users work on common documents.

So ignore the hype and accept the current limitations of the Net. If you need to collaborate with colleagues, clients, and the like, the Net is going to be the medium of choice for people who pay their own phone bills. Services will improve, and collaborative multimedia applications are coming. **B**

Bob Emmerson is a BYTE correspondent who is based in Eindhoven, The Netherlands. David Greetham is a consultant with Greetham Associates in Turnhout, Belgium. You can contact them at **73252.1364@compuserve.com** *and at* **editors@bix.com**, *respectively.*

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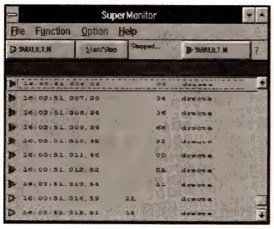

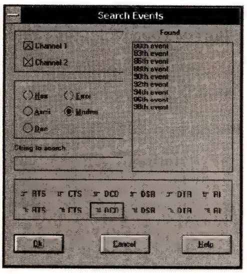

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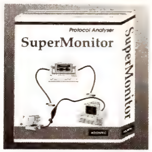

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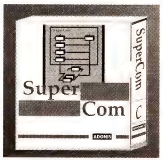

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Motherboards Smarten Up

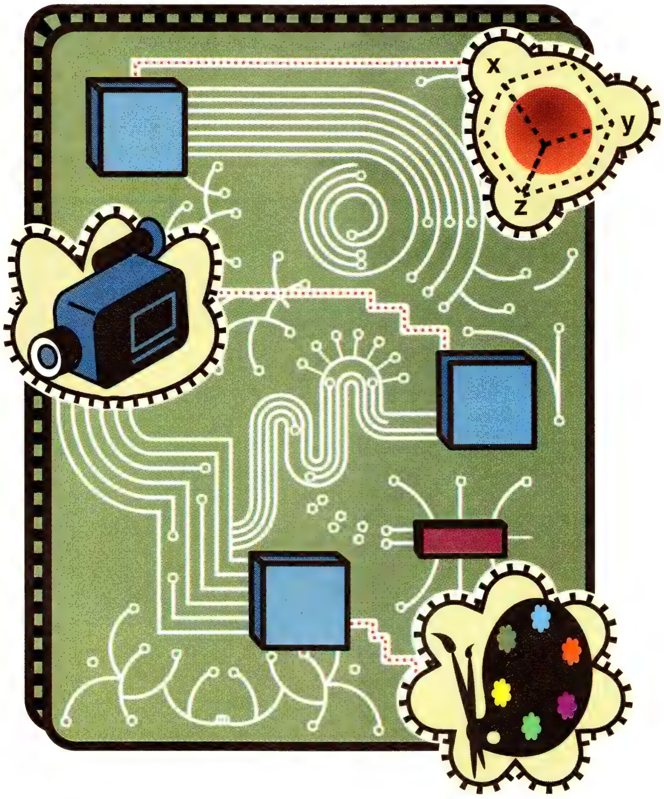
A look at the changing ATX and baby-AT USB Pentium and Pentium Pro motherboards from Taiwan.

By Mark LaPedus

Although they may look similar to the casual observer, PC motherboards can differ widely. The rapid shift toward faster processors, complex OSes, 3-D graphics, and Internet-access capabilities on common PCs is causing a sea change in board design.

Board makers are not only scrambling to support the next wave of CPUs but also implementing a complex array of new components and technologies. This includes new PC chip sets, multimedia chips, memories, and bus designs. These new technologies will be incorporated into the current PC-board form factors, baby-AT and LPX, as well as the emerging ATX standard.

"More and more functions are being put on boards," says Jerry Lee, associate vice president for Asustek, a Taiwan board maker. "New VGA controllers, sound chips, MPEG, and other functions are being integrated on the board, especially for home PCs." As a result, PC and board designers are scrambling to solve growing problems in the systems arena. One is squeezing more performance and bandwidth out of the already-constrained PC architecture.



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General Trends

One place to look for some (but not all) of the answers to the problems of board design is Taiwan, the world's largest maker of boards, according to the government-sponsored Market Intelligence Center (MIC), located in Taipei. Taiwanese vendors will boost their total board shipments from 20.9 million units in 1995 to 25 million this year, says Colley Hwang, director of the MIC. Other board suppliers are located in China, Hong Kong, India, Korea, and Singapore, but Taiwan is still considered the PC-clone capital of the world.

Meanwhile, Intel is the world's single largest motherboard vendor. The U.S.-based company, which bundles boards with its own processors and chip sets, reportedly is expected to increase its motherboard shipments from about 6 million to 8 million units in 1995 to around 10 million this year, analysts say.

Intel is moving toward the high-end board business. But Taiwan also offers a glimpse of what's ahead, because it focuses on mass markets. In fact, by the end of this year (or even sooner), Taiwanese companies will ramp up products that will use the following—sometimes competing—technologies.

- ATX form factor
- universal serial bus (USB)
- next-generation CPU support (e.g., Intel's P55C and Cyrix's M2)
- multimedia boards (for 64-bit VGA, 16-bit sound, MPEG, TV output, and LANs)
- Unified Memory Architecture versus non-UMA (e.g., Intel's Natoma and Triton II chip sets)
- 72-pin SIMMs versus 168-pin DIMMs (for fast-page mode, EDO, and SDRAM)
- multimedia (NSP versus DirectX)

Unlike Intel, Taiwanese outfits do not ship motherboards with the CPU on the board. But Taiwan-made boards are more flexible; they're optimized to run with x86-based chips from AMD, Cyrix, Intel, and others. In addition, some Taiwanese firms sell boards designed for the PowerPC and other RISC chips. Not surprisingly, Intel's boards support microprocessor units (MPUs) from one vendor: Intel.

Previously, Taiwan-made boards used less-expensive chip sets from several third parties, including Opti, SIS, UMC, VLSI, and a host of others. But Intel now has a big lead in chip sets, while competitors are three or more months behind, says Bernie Tsai, vice president and general manager for Acer's Component Service Business Division.

So, for the foreseeable future, most Taiwan-made boards will use Intel's reliable—but more expensive—chip sets, including the Triton II for Pentium-class PCs and the Natoma for Pentium Pro–based workstations and servers. Introduced earlier this year, the Triton II includes the 430HX for Pentium-based business PCs and the 430VX for Pentium-based home PCs.

A Dinosaur Architecture

To some, the current PC architecture is a dinosaur. In his famous speech during Fall Comdex nearly two years ago, Intel CEO Andrew Grove called for the need to transform the PC architecture to access what was then referred to as the "information superhighway"—now, arguably, the Internet.

At the time, Grove also created a stir by announcing native signal processing (NSP), a scheme that would migrate all digital signal processor (DSP) functions to the MPU. NSP promised to not only boost PC performance but also to reduce systems cost by eliminating the proliferation of add-in boards and connector wires that were choking the PC, according to Grove.

What's changed during the past two years? Intel's NSP has been altered, but few functions have been totally shifted to the CPU. New CISC and RISC MPUs running at 200 MHz and faster on a 66-MHz bus offer more power than ever before. But the current data-processing requirements of the CPU, coupled with bulky OSes, such as Windows 95 and NT, are still causing today's PCs to gasp for air.

Bandwidth also remains a major bottleneck. For example, a 1024- by 768-pixel monitor configured to run MPEG-1 video at 30 frames per second requires a data stream of about 47.2 Mbps. This leaves little room for emerging technologies, such as 3-D video, 128-bit PCI graphics, and other functions.

Different Form Factors

Some NSP concepts, however, are beginning to surface in a surprising and unlikely area: the board form factor. In the past, PC vendors relied on three basic form factors: full-size AT, baby-AT, and LPX.

The full-size AT form factor was one of the standards in the PC's early days, but its cost and size have since limited it to niche markets. During the past several years, the baby-AT and LPX form factors have become more popular because of their smaller footprints and cost savings.

Suddenly, however, there's been a dramatic shift in form-factor design. Last year, Intel released the specifications for its new, internally developed board form factor, ATX, which supports Pentium- and Pentium Pro-class MPUs. "If you look at the PC, it's an old architecture," says Geoff Healey, regional sales and marketing manager of the OEM Products and Services Division at Intel's Asia-Pacific headquarters in Singapore. "ATX was an effort to update the motherboard design."

Indeed, ATX is an evolution of the baby-AT form factor. Essentially, it's a baby-AT baseboard rotated 90 degrees, equipped with a new chassis enclosure and mounting configuration for the power supply.

Its benefits are obvious. The power supply directly cools the CPU instead of the add-on cards, making a secondary fan

Pentium ATX Boards from Taiwan

	PENTIUM PRO						
	Acer	**Elitegroup**	**Elitegroup**	**FIC**	**Acer**	**Asustek**	**Elitegroup**
Model	AX65	P6FX1-A	P6FX2-A	PN-6210	AX53	P/I-XP55T2P4	P5HX-A
CPU support	All Pentium Pro CPUs	All Pentium Pro CPUs	One or two Pentium Pro CPUs	One or two Pentium Pro CPUs	All Pentiums	All Pentiums	Pentium, Cyrix 6x86, AMD
Chip set	Intel 440FX PCIset	Intel 440FX PCIset	Intel 440FX PCIset	Intel 440FX PCIset	Intel 430HX PCIset	Intel 430HX PCIset	Intel 430HX PCIset
Cache	Built-in	Built-in	Built-in	Built-in	256 KB	256/512 KB	256 KB
Architecture	ISA/PCI	ISA/PCI	ISA/PCI	ISA/PCI	ISA/PCI	ISA/PCI	ISA/PCI
Maximum main memory	512 MB	ND	1 GB	ND	512 MB	8/256 MB	ND
SIMM type	Four 128-MB	ND	ND	ND	Four 128-MB	Four 64-MB	ND
BIOS	AMI/Award	ND	ND	ND	AMI/Award	ND	ND
On-board I/O	Two serial ports One parallel port Two-channel mode Bus-master IDE One floppy drive connector Two-channel USB ports	Two serial ports One parallel port Two-channel mode Bus-master IDE One floppy drive connector Two-channel USB ports	Two serial ports One parallel port Two-channel mode Bus-master IDE One floppy drive connector Two-channel USB ports	Two serial ports One parallel port Two-channel mode Bus-master IDE One floppy drive connector Two-channel USB ports	Two serial ports One parallel port Two-channel IDE One floppy drive connector Two-channel USB ports	Two serial ports One parallel port Two-channel IDE One floppy drive connector Two-channel USB ports	Two serial port One parallel p Two-channel I One floppy dri connector Two-channel USB ports
Expansion slots	Three 16-bit ISA; four 32-bit PCI	Three 16-bit ISA; four 32-bit PCI	Three 16-bit ISA; four 32-bit PCI	Three 16-bit ISA; four 32-bit PCI	Three 16-bit ISA; four 32-bit PCI	Three 16-bit ISA; four 32-bit PCI	Four 16-bit ISA three 32-bit PC
Board size (mm)	305 by 244	305 by 244	305 by 244	305 by 244	305 by 244	305 by 244	305 by 244
Other features	N/A	N/A	N/A	N/A	N/A	N/A	N/A

ND = information not disclosed by company; N/A = not applicable.

or active heat sink unnecessary. In addition, the processor has been relocated away from the expansion slots, allowing them to hold more full-length add-on cards. The number of such cards that can be added depends on the design.

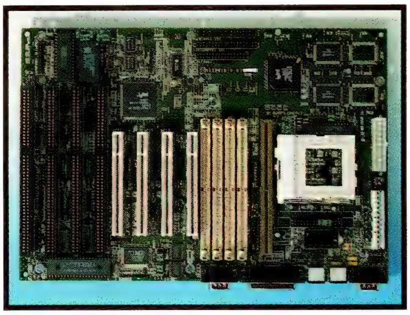
ATX also defines a stacked I/O area, called the *multimedia I/O back panel*, which is located to the rear of the chassis and measures 6¼ inches (158 mm) by 1¾ inches (44.5 mm). This panel features several stacked I/O ports, including serial, parallel, keyboard, mouse, audio, MIDI, and VGA connector. LAN, modem, and ISDN connectors can also be added to this I/O panel, according to Intel.

Another key for ATX—as well as baby-AT and LPX—is support for USB. With USB, only one peripheral device needs to be plugged directly into a PC. Other devices—such as a keyboard, mouse, modem, printer, scanner, and speakers—connect to an expansion hub that's built into the keyboard, the monitor, or a standalone USB device. With a transfer rate of 12 Mbps, USB lets you connect up to 127 different devices to a single PC.

In other words, the standard positioning of USB and other I/O connectors in the ATX design allows for more flexibility and functionality on PCs, Healey explains. In comparison, a typical I/O back panel in today's PCs has just two serial ports, a mouse port, a keyboard port, and a parallel port.

ATX cuts overall system costs, Healey adds. The number of cables and add-in cards is reduced by integrating more I/O onto the board with better positioning of the hard and floppy drive connectors. One major benefit is that, unlike a baby-AT design, which requires two PC connectors and cable assemblies, the ATX needs only one, comments Asustek's Lee.

ATX is also flexible. Like the current baby-AT boards, it supports up to seven expansion slots, which can be any combination of ISA, PCI, and shared ISA/PCI. ATX boards come in two sizes: A full-size version measures 12 by 9.6 inches (305 by 244 mm), while a mini-ATX measures 11.2 by 8.2 inches (284 by 208 mm).



The Mycomp ATX board.

PENTIUM				
FIC	**FIC**	**FIC**	**FIC**	**Mycomp**
PAK-2010	PAK-2110	PTK-2010	PTK2110	TI5TH
Pentium, Cyrix 6x86, AMD	Pentium, Cyrix 6x86, AMD	Pentium, Cyrix 6x86, AMD	Pentium, Cyrix 6x86, AMD	All Pentiums
VIA 580VP	VIA 580VP	Intel 430HX PCIset	Intel 82430HX PCIset	Intel 430HX PCIset
256/512 KB	256/512 KB	256/512 KB	256/512 KB	256/512 KB
ISA/PCI	ISA/PCI	ISA/PCI	ISA/PCI	ISA/PCI
512 MB	512 MB	512 MB	512 MB	128 MB
ND	ND	ND	ND	ND
ND	ND	ND	ND	ND
Two serial ports One parallel port Two-channel IDE	Two serial ports One parallel port Two-channel IDE	Two serial ports One parallel port Two-channel IDE	Two serial ports One parallel port Two-channel IDE	Two serial ports One parallel port Two-channel IDE
One floppy drive connector Two-channel USB ports Four 16-bit ISA; three 32-bit PCI	One floppy drive connector Two-channel USB ports Four 16-bit ISA; three 32-bit PCI	One floppy drive connector Two-channel USB ports Four 16-bit ISA; three 32-bit PCI	One floppy drive connector Two-channel USB ports Four 16-bit ISA; three 32-bit PCI	One floppy drive connector Two-channel USB ports Four 16-bit ISA; four 32-bit PCI
305 by 244	305 by 244	305 by 244	305 by 244	305 by 244
64-bit VGA on-board	64-bit VGA on-board; 16-bit sound on-board	64-bit VGA on-board	64-bit VGA on-board; 16-bit sound on-board	N/A

ATX isn't perfect, however. First, PC cases and chassis must be redesigned to fit the ATX form factor. Second, some heat-dissipation issues still exist, because there's no direct cooling of the add-on cards in the system. Finally, few power supplies on the market conform to the ATX standard. "The material costs for the board are also slightly higher than for the baby-AT," notes Lee.

The baby-AT and LPX form factors won't die—yet. However, "ATX is the future," says Charles Kan, director of sales for Elitegroup's PC Business Unit. Elitegroup projects that nearly 50 percent of its board business could come from ATX products by the end of this year.

Different Configurations

Taiwanese board vendors have for years offered two kinds of motherboard products: basic and all-in-one configurations. Both can be configured into the baby-AT, LPX, or ATX form factors, and they can also be optimized for Pentium- and Pentium Pro–class MPUs.

The basic board configuration offers such features as a PC chip set, a built-in cache (in Pentium designs), 4- by 72-pin SIMMs, flash memory, ISA and PCI slots, one parallel port, an Infrared Device Association (IRDA) infrared port, and two serial ports, which support a 16650 fast universal asynchronous receiver/transmitter (UART) chip.

All-in-one boards are designed for so-called all-in-one PCs. They have a combination of multimedia ICs on-board, including VGA, sound, MPEG, and, in some cases, LAN chips, among other features.

All-in-one boards have been around for a long time, but they are now moving toward a higher integration of components and features. For example, First International Computer of Taiwan is making a big push in this area with boards that include 16-bit sound chips and 64-bit VGA controllers that support 3-D graphics and software-based MPEG. FIC also offers basic and all-in-one boards for Pentium- and Pentium Pro–based CPUs.

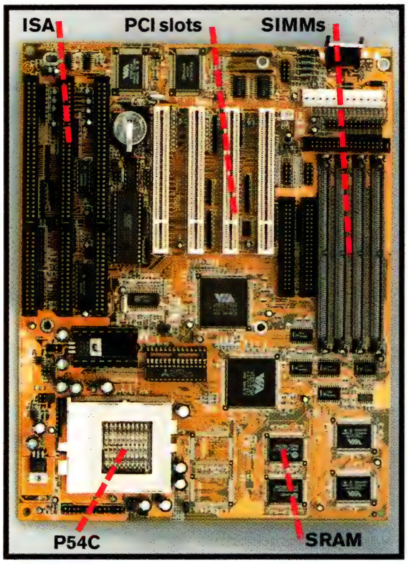
FIC was one of the first vendors in Taiwan to offer Pentium Pro–based boards, the PO-6000 and PO-6200. Both "provide the power and salability for high-performance workstation and server applications," says Ernest Chen, vice president of FIC's Personal Computer Division.

The PO-6000 is optimized to support four versions of the Pentium Pro processor, including the 150-, 166-, 180-, and 200-MHz models. The PO-6200 board, which is designed for higher-end systems, supports single- and dual-processor computers based on the P6.

The PO-6000 and PO-6200 are built around Intel's current P6-based chip set, the 450KX PCIset. FIC also plans to offer boards with Intel's new Natoma chip set, as well as a P6-based core-logic line from Via, a California-based design house.

A major advantage of Taiwanese companies' boards is that they support several types of CPUs, chip sets, and memories, all from a variety of vendors. This is made possible by the use of jumpers or a voltage-regulator module (VRM), which allows changes in the voltages and speed grades among different MPUs.

VRMs will support next-generation MPUs, including Intel's forthcoming Pentium-level chip, code-named the P55C, which will incorporate on-board multimedia instruction sets, or Visual Instruction Sets (VISes). The P55C will roll out this year in 150-MHz and faster grades.

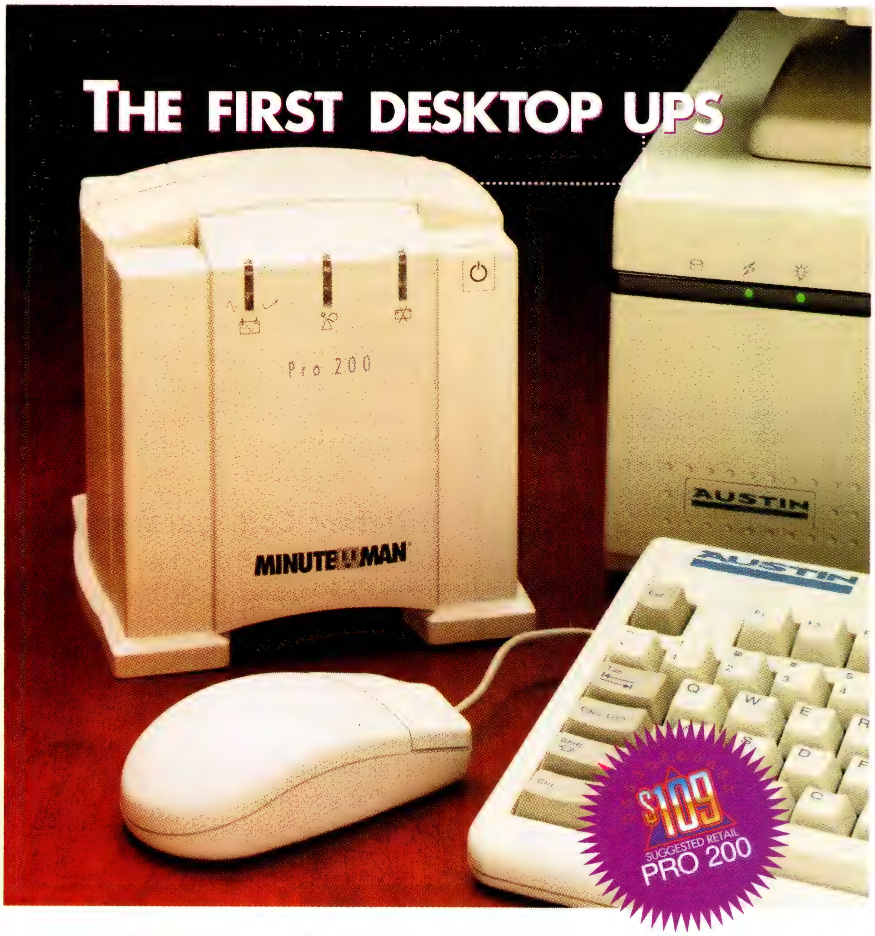


First International Computer's baby-AT board.

Chip-set support is perhaps the most critical issue for PC boards. Initally, Taiwan's boards will support Intel's Triton II chip set for Pentium CPUs, as well as the newer Natoma chips for the Pentium Pro. But Taiwan hopes to shift to less-expensive chip sets from third parties, thereby driving down board prices. For example, company officials say that FIC uses a chip set from Via that includes a two-chip core-logic device that was designed for Via's own Pentium Pro–based boards.

A possible key to PC chip sets is the aforementioned Unified Memory Architecture (UMA), which reduces overall system cost by as much as $40 to $50. The idea behind UMA is its ability to share and access the main memory in a system, thereby eliminating the need for dedicated graphics frame buffers. Third-party companies, including Opti and SIS, have endorsed UMA.

UMA isn't the perfect solution, however. In UMA systems, the CPU and graph-



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ics contend for DRAM bandwidth. This increases the average time that it takes the CPU to access the DRAM, cutting system performance by 15 percent to 25 percent.

To make matters worse, Intel uses its own UMA standard on the Triton II. In fact, Intel does not even support the UMA standard proposed last year by the so-called VESA Committee, an organization backed by Opti, VLSI Technology, and just about every competitor of Intel.

Is UMA dead in the water? "It may be an option for entry-level systems, but not for Pentium Pro–based products," Lee concludes. Still, PC and motherboard designers hope to eliminate the UMA bottleneck by using new, higher-bandwidth DRAM types, including synchronous DRAM (SDRAM), RAMbus, multibank, and others.

But Taiwan-made boards appearing this year will mainly make use of current and less-expensive DRAM types, including fast-page mode and extended data out (EDO). By midyear, SDRAMs will become an option as they reach price/performance parity with EDO DRAMs, Lee says.

In the past, Taiwanese boards used 72-pin SIMMs—equipped with current fast-page mode and EDO DRAMs. Later this year, PC boards will begin to surface that use 168-pin dual-in-line-memory modules (DIMMs)—using either fast-page mode, EDO, or SDRAMs. "Both 72- and 168-pin modules will be standard," says one board maker.

Intel's original NSP hardware and software plans didn't conform to Win 95, causing Microsoft to change its plans late last year. Now, Intel's NSP Reference Platform lives in Microsoft's DirectX API for Win 95. Taiwan, of course, must support the standards as they rise—or fall.

Still, despite the demise of Grove's original NSP dream, the PC is moving slowly but surely toward a capable multimedia platform. With ATX, USB, and other enabling technologies, PC-board companies will also be able to simplify their designs.

However, as new PC-board designs evolve, price still remains the single most important factor for Taiwanese companies as they attempt to differentiate their products while operating within razor-thin profit margins. The profit margin for PC boards has been hovering around just 2 percent or so for the last few years.

This has put the future of many Taiwanese companies in limbo, especially the small- to mid-size suppliers. There were nearly 200 Taiwanese board makers in the early 1990s; now there are only 15 active suppliers in Taiwan, according to the MIC. Says Acer's Tsai: "Whoever can get enough CPUs and chip sets from Intel may be the eventual winner." **B**

Mark LaPedus is a BYTE contributing editor based in Taipei. You can reach him at **591-6955@mcimail.com.**

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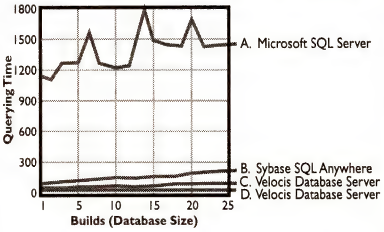

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What's New

PREVIEW

Spiderman 2000
DM 999 for V.34 version;
DM 699 for V.32 version

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on Inquiry Card.

Martignoni Electronics AG
Zurich, Switzerland
+41 1 4471148
fax: +41 1 4471100

An Answering Machine for Faxes

SpiderMan 2000 is a giant step ahead of standard fax/modems because your PC or Mac doesn't need to be turned on to receive faxes and voice messages. The SpiderMan 2000 V.34 modem includes 1 MB of memory (expandable to 16 MB with standard SIMMs). Once you've programmed the device, it runs independently from the computer and handles incoming messages even while you're on the road.

SpiderMan links to any popular printer. You can choose whether you want to print incoming faxes directly, store them in memory, or automatically upload them in the computer's fax software. If you choose to print directly, SpiderMan works like a standard fax machine that first stores the whole fax in memory and then prints it on your local printer.

SpiderMan also lets you download received faxes remotely or automatically redirect incoming faxes to any fax destination. Faxes with extremely high gray-scale information can easily exceed 1 MB and overload SpiderMan's memory. However, it can store up to 20 standard business documents and 10 minutes of voice messages. If you get faxes with a lot of graphics, you can choose the "print directly and then delete stored fax" option or upgrade SpiderMan's memory to make sure you don't lose information. **–Rainer Mauth**

Storage

Six- and Eight-Speed CD-ROM Drives

Elitegroup's Vertos ESD CD-ROM drives come in four-, six-, and eight-speed configurations, with faster versions in the works. The drives come in a half-height, 5¼-inch form factor and have an enhanced IDE AT-API interface. All Vertos CD-ROM drives conform to several formats, including CD-DA, CD-ROM XA, CD-I FMV, Video CD 2.0, and CD Plus Format. The drives all offer low-power features, including an automatic shutdown mode.

Price: Call company.
Elitegroup Computer Systems Co. Ltd., Taipei, Taiwan, +886 2 896 5859; fax +886 2 895 1294.
Circle 1046 on Inquiry Card.

CD-ROM Server Manages Up to Seven Drives

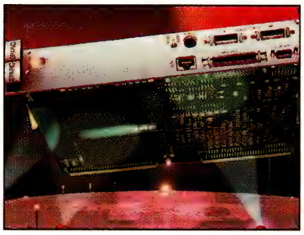
The DP300 is a series of SCSI-2-based CD-ROM servers with up to seven CD-ROM drives that can run in Ethernet or token-ring LANs. The machines deploy quad- and six-speed drives that you can access via the following network protocols: IPX, TCP/IP, and NetBEUI. DP300 servers work autonomously as regular file servers without requiring additional access software. Their external SCSI connectors allow you to link additional SCSI devices.

Price: Starts at DM 5000.
dtS Computer, Siegen, Germany, +49 271 3842 150; fax +49 271 3842 162.
Circle 1022 on Inquiry Card.

System

New Dual-Processor HyperSparc Module

The SPARC CPU-10 is a dual-processor HyperSparc MBus module that runs 125- and 150-MHz processors and allows for the deployment of up to 192 MB of RAM. It is binary-compatible with Sun workstations and is geared toward processing telecommunications and control applications. Due to its compact design, it occupies just two VME connectors.



Price: Call company.
Force Computers, Munich, Germany, +49 89 608140; fax +49 89 6097793; info@force.de.
Circle 1024 on Inquiry Card.

Video CD Player

Behavior Tech Computer's BTC VCS-B1 video CD player can connect into either a PC or TV, making it ideal for home entertainment and business applications. Based on the MPEG-1 and VCD 2.0 standards, the VCS-B1 can play CD Audio, CD-I, VCD 1.0/1.1/2.0, and Karaoke CD discs. The video CD player from BTC can also automatically detect which

Hardware

An all-in-one communications package, an industrial-strength label printer, and a tool to port Visual Basic code.

type of CD is inserted into the machine, providing easy switching between audio, video, games, and karaoke functions, as well as NTSC and PAL TV systems.
Price: Call company.
Behavior Tech Computer Corp., Taipei, Taiwan, +886 2 523 6266; fax +886 2 523 3114.
Circle 1047 on Inquiry Card.

Networks

LAN-WAN Internetworking Router

SIEMENS' NETWORK-MODEM-ROUTER IS a stand-alone unit that includes its own CPU and manages LAN-LAN and LAN-WAN internetworking via telephone lines. It allows telephone numbers to be incorporated into router tables and supports TCP/IP, telnet, and FTP. It incorporates a battery-buffered real-time clock and supports batch mode.
Price: DM 2390.
Siemens ANL, Langen, Germany, +49 69 7975702; fax +49 69 7975672.
Circle 1025 on Inquiry Card.

Fast Ethernet Cards and Hubs

LITE-ON COMMUNICATIONS' FAST ETHERnet products, including the LF560, LF6008, and LF6012, are designed for use in 10- and 100-Mb operations. The LF560 is a LAN card; the LF6008 and LF6012 are switching hubs designed for use in both PC and Mac platforms. The LF560 adapter card has an auto-sensing function that can automatically move the operations from 10 to 100 Mb, thereby providing an easy migration path to the fast Ethernet standard. The LF6008 has eight 100-Mb ports (100Base-TX), while the LF6012 has 12 ports.
Price: Call company.
Lite-On Communications Corp., Taipei, Taiwan, +886 2 773 6650; fax +886 2 711 1564.
Circle 1044 on Inquiry Card.

Virtual Router for Networks

VGATE IS A VIRTUAL ROUTER THAT IS INTERoperable with any Ethernet LAN switch. It offers low latency with wire-speed IP and IPX routing among switched Ethernet LANs as well as between VLANs. Vgate is SNMP-compliant and available in two- and four-port versions. Up to 64 VLANs can be supported by a single Vgate. When a LAN switch is attached to a Vgate port, the corresponding IP and IPX VLAN addresses are defined. VLANs can span one or more switches and one or more Vgate ports. Thus, moving workstations does not require reconfiguration of the addresses.
Price: From $3000.
RAD Network Devices, Tel Aviv, Israel, + 972 3 6458555; fax + 972 3 6487368; Barrys@rnd.rndmail.rad.co.il; www.rnd-home.com.
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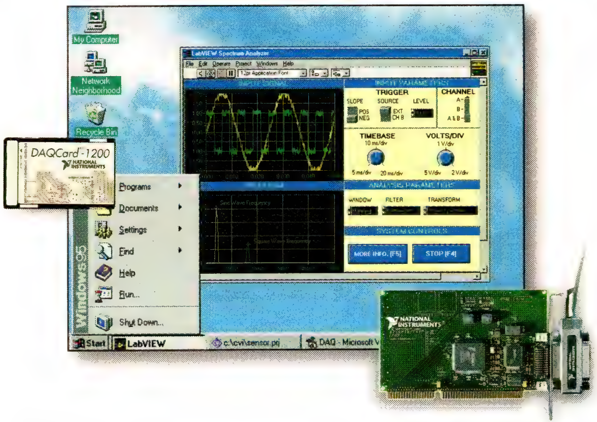

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Price: Call company.
RAD Network Devices, Tel Aviv, Israel, +972 3 6458555; fax +972 3 6487368; Barrys@rnd.rndmail.rad.co.il; www.rnd-home.com.
Circle 1023 on Inquiry Card.

ISDN Terminal Adapter Supports Bandwidth on Demand

The new version of the Ultimate TA ISDN terminal adapter includes Virtual Leased Line and Bonding capabilities. The device lets users combine two 64-Kbps channels and is compatible with the U.S. Bandwidth on Demand Interoperability Group. It supports asynchronous data transfer through quick connections to a prestored remote destination number, thereby letting small businesses deploy leased lines.

Price: Starts at £495.
Paxdata Networks, Hemel Hempstead, U.K., +44 1442 236336; fax +44 1442 236343; info@paxdata .com.uk.
Circle 1026 on Inquiry Card.

Fast Ethernet ICs

Realtek's communications ICs support the 100-Mb fast Ethernet standard. The RTL8129 is a single-chip controller that supports both 10- and 100-Mb operations. The RTL8301 is designed for use in 100Base-T fast Ethernet packet-switching applications, including LAN hubs. Being compliant with the IEEE-802.3U 100Base-T specification, Realtek's RTL8129 can automatically switch from 10- to 100-Mbps operations via an auto-detection system. It comes in a 160-pin PQFP package. The RTL8301 is used for switching hubs and includes two ports, expandable to 32 ports. It's offered in a 208-pin PQFP package.

Price: Call company.
Realtek Semiconductor Corp., Hsinchu, Taiwan, +886 35 780 211; fax +886 35 776 047; cn@realtek.com.tw; http://realtek.com.tw.
Circle 1048 on Inquiry Card.

Monitor

17-inch Multimedia Color Monitor

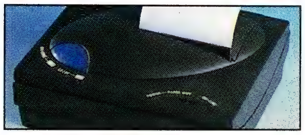
Mitac's 1769FD 17-inch multimedia color monitor delivers a resolution of 1280 by 1024 pixels at 60 Hz, with a dot pitch of 0.28 mm and horizontal and vertical frequencies of 30 to 69 kHz. Designed for a wide range of multimedia applications, the 1769FD incorporates a built-in 8-W subwoofer and two 3-W twitter speakers. It also has a digital on-screen display setting for use in programming and is DDC-compliant.

Price: Call company.
Mitac International Corp., Taipei, Taiwan, +886 2 501 8231; fax +886 2 501 4265; market@smtplink.mic.com .tw; http://mitac.mic.com.tw/.
Circle 1043 on Inquiry Card.

Printers

Industrial-Strength Label Printers

The Investix DX 58 and DX 60 thermal 2-inch printers are multifunc-



tional units that can print labels, tickets, bar codes, tags, and stickers. A Windows labeling program lets you construct databases with up to 32,000 addresses and create true WYSIWYG labels. The software is available in English and French.
Price: Call company.
Investix, Paris, France,
+33 1 44635757;
fax +33 1 44635750;
moreinfo@investix.com.
Circle 1028 on Inquiry Card.

Processor

32-bit Embedded RISC Processor

MACRONIX'S MXR3500 32-BIT PROCESSORS are based on the R3000 RISC technology from Mips Technologies. Designed for embedded applications, including laser printers and networking cards, the MXR3500 is a single-chip, 40-MHz product that runs at 28 MIPS. It includes power management features and on-chip cache memory. The MXR3500 is also available in the form of an ASIC core. This core measures 5.2 mm (square), the smallest RISC core in the 32-bit embedded market.
Price: Call company.
Macronix International Co. Ltd., Hsinchu, Taiwan, +886 35 788 888; fax +886 35 788 886.
Circle 1045 on Inquiry Card.

386SX-Based PC-on-a-Chip

ACER LABORATORIES' PC-ON-A-CHIP product line is designed for PDAs, hand-held games, and other 32-bit embedded applications. The M6117 chip from Acer combines Intel's 386SX MPU core and Acer's M1217B chip set—all on the same device. Acer recently licensed the 386SX core technology from Intel. The M6117 comes in 25- and 40-MHz versions, operating at 3.3 and 5 V, respectively.

The M6117 also includes a DRAM controller, a DMA controller, a coprocessor interface, an ISA interface, a keyboard controller, and many other on-board features.
Price: Call company.
Acer Laboratories, Inc., Taipei, Taiwan, +886 2 762 8800;
fax +886 2 762 6060;
alan.pan@ali.com.tw.
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PHILIPS' DESKTOP VIDEO CAMERA FEATURES simple mechanics for swivel and pan movements and a variable-focus lens. An integrated microphone provides live audio. The camera allows for easy hand-held or free-standing filming in every direction. It includes white balance freeze mode and backlight compensation. The camera can be used for videoconferencing and interactive document editing.

Price: Call company.
Philips Consumer Electronics, Eindhoven, The Netherlands, +31 40 2734 866;
fax +31 40 2733 512.
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SMARTLOCK is the integrated protection system which assures total PC and LAN security: unauthorized access to computers, input of illicit software into company PCs, viruses, illicit use of personal computers. Remote and integrated management for LAN applications.

PC access control
Prevents unauthorized access to PC. Provides an audit trail recording application programs executed, users and login times. Prevents unauthorized booting. Limits the use of floppy disk drives and peripherals. Executes on-the-fly transparent cryptography of the hard disk.

Company software control
Prevents unauthorized execution of illicit unlicensed software. Takes census of company software. Allows controlled distribution of new software licenses via digitally tagged floppy disks.

Antivirus
Provides the final solution to the software virus problem without requiring continuous updating. Takes preventive action by intercepting the viruses before they enter the PC, regardless of the type and techniques of attack.

Increases performance
Prevents the import of useless software (games, shareware, demos, etc.). Avoids accidental deleting or modifying of files containing vital data. Prevents from modifying CONFIG. SYS and AUTOEXEC. BAT system files.

EUTRON 24048 Treviolo Bergamo Italy - Via Gandhi, 12 Tel. +39-35-201003 Fax +39-35-201277 e-mail eutron@mbox.vol.it

■ Belgium: Akkermans 03-2338826 ■ Bulgaria: Vilmat 02-764533 ■ Finland: Dalma 90-2711800 ■ France: Logidata 1-46454546
■ Slovenia: Stubelj 065-63215 ■ Sweden: JM Data 042-123145 ■ Spain: Larcu 91-7952413 ■ The Netherlands: Akkermans 045-5241444

Eutron

Circle 704 on Inquiry Card (RESELLERS:705).

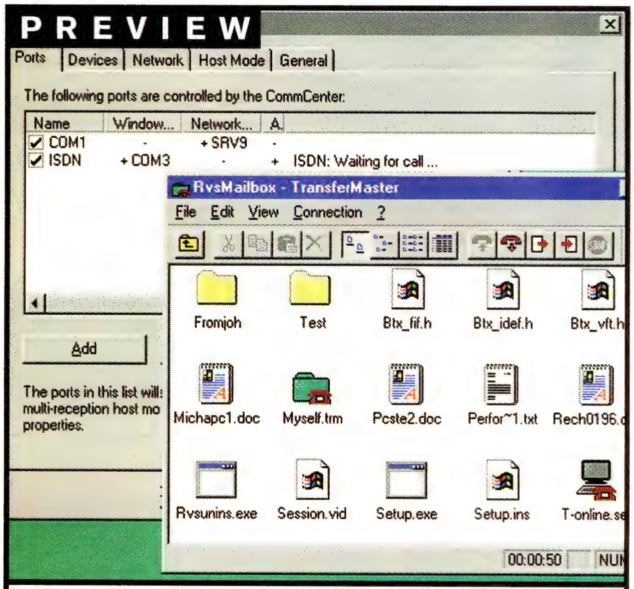
SOFTWARE

Business

Interface Integrates SAP and Metaphase

SIEMENS ANL DEVELOPED A SOFTWARE interface that integrates the Metaphase product management system and SAP business management software. The new software interface allows the user-controlled exchange of parts lists and material master data between the two systems. It features a modular, object-oriented design and can be configured to suit specific needs. The program supports SAP R/2 V.5.x, SAP R/3 V.2.2, and Metaphase V2.x. It provides archiving and retrieval of documents.

Price: Call company.
Siemens ANL, Mannheim, Germany, +49 621 4563324; fax +49 621 4562867.
Circle 1055 on Inquiry Card.



The following ports are controlled by the CommCenter:

Name	Window...	Network...	A.
☑ COM1	-	+ SRV9	-
☑ ISDN	+ COM3	-	+ ISDN: Waiting for call ...

The ports in this list will: multi-reception host mo properties.

RVS-COM for Windows
DM 760

Circle 1049 on Inquiry Card.

RVS Datentechnik GmbH
Munich, Germany
+49 89 357157 0
fax: +49 89 357157 99

RVS-COM: One Communications Program for ISDN and Modems

The new version of RVS-COM for Windows 95 provides powerful communications capabilities for modems and ISDN. It lets you control virtually any kind of data communications on a PC, such as file and fax transfer, terminal emulation, remote control, mailbox, and Internet access. It gives you the same functionality if you use a modem or an ISDN board. In addition, the program provides direct e-mail transfer from the Microsoft Exchange client to any remote PC. After connecting two Windows 95 PCs with RVS-COM, you can copy files from a remote machine by simply dragging and dropping the icons, as in Windows 95 Explorer.

RVS-COM for Windows 95 closely integrates with Windows 95 in that it supports TAPI, UniModem, VCOMM, MAPI, and OLE. It seamlessly extends Windows 95 communications to ISDN and gives all you need for data communications in business and at home.

–Rainer Mauth

Database

Database Query Tool

QLIKVIEW IS AN EASY-TO-USE DATA-QUERY tool that features an associative interface. The software eliminates tables and joins and instead presents data graphically. With the product, you can link descriptive text, pictures, and multimedia information; construct expert systems; and produce catalogs. QlikView can be run with different screen resolutions. The Windows program comes in a 16- or a 32-bit version and supports ODBC.

Price: About DM 1100.
QuikTech AB, Lund, Sweden, +46 46 182700; fax +46 46 182661; info@quiktech.se.
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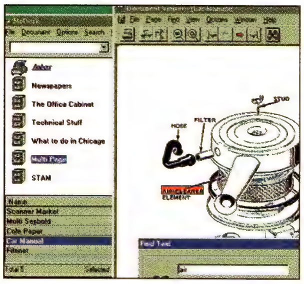
Search Original Documents

MYDESK FROM IOTA INDUSTRIES IS WINDOWS-based software that enables on-image information searches of original documents without having to rely on separate OCR-generated text files and preserving all original fonts and graphics. MyDesk is based on Iota's Smart Image Technology (SIT), which employs proprietary adaptive probability pattern recognition to interpret geometric text patterns for text recognition and retrieval. SIT automatically converts documents from any input sources, including incoming faxes, scanned images, brochures, news clippings, and digital documents, into Searchable Image Format (SIF), which permits the creation of TIFF-compatible, multiplatform electronic documents. SIT supports TWAIN interfaces to most scanners and automatically converts SIF documents to and from TIFF, PCX, BMP, and other formats. MyDesk products are available for SOHO environments and network applications.



Price: Call company.
Iota Industries Ltd., Tel Aviv, Israel, + 972 3 6913060; fax + 972 3 6913050; info@iota.co.il.
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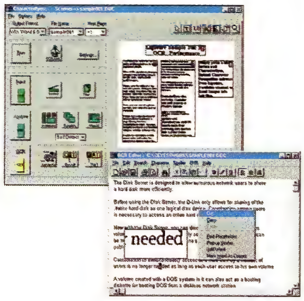
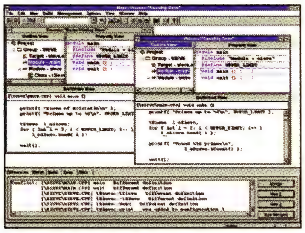


Price: Call company.
Ligature, Jerusalem, Israel, +972 2 6513553; fax + 972 2 6513395; ligature@netvision.net.il.
Circle 1050 on Inquiry Card.

Developer Tools

Object-Oriented Approach to Team Programmers

HOPE, THE HUMAN-ORIENTED PROgramming Environment from Aladdin Software, is an object-oriented team development tool suite whose features include on-line



information sharing between team members, locking of fine-grained objects, smart merge tools, Import Wizard for ongoing projects, full control of the development project, and real-time change management. HOPE automatically saves all changes to its "particles" (i.e., member functions, classes, variables, or even modules) in its repository rather than in plain text files, letting any number of programmers work concurrently on the same code. HOPE automatically detects and resolves logical conflicts in code written by different team members. HOPE runs under Windows 3.x, NT, and 95.
Price: Call company.
Aladdin Knowledge Systems, Tel Aviv, Israel, + 972 3 5375795; fax + 972 3 5375796; aladdin@aladdin.co.il; www .aks.com/hope/hope.htm>.
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CASE Tool Supports Bidirectional Code Generation

SELECT OMT PROFESSIONAL WORKBENCH 5.0 is an object-oriented modeling tool that supports Rumbaugh's Object Modeling Technique and Jacobsen's Use Case techniques. Version 5.0 supports on-line processes and automatic diagram construction. It includes a hypertext guide to the Select development approach. Other new features are the ability to partition object models into subsystems and full support for data typing and round-trip engineering.
Price: Starts at £995.
Select Software Tools, Cheltenham, U.K., +44 1242 229700; fax +44 1242 229701; Virginia@selectuk.mhs .compuserve.com.
Circle 1060 on Inquiry Card.

SGML Toolkit

IDM IS A TOOLKIT FOR DEVELOPERS OF SGML systems that hides much of the complexity of SGML behind an easy-to-understand interface. It features a suite of formatting engines to allow automatic conversion from SGML documents to Windows Help, Lotus Notes, or HTML files. The product comes in a Professional Edition, which includes a comprehensive API, and in a Personal Edition, for users with minimal knowledge of SGML.
Price: $495 for the Personal Edition; Professional Edition starts at $4500.
Digitome Ltd., Dublin, Ireland, +353 1 6621499; fax +353 1 6621056; digitome@iol.ie.
Circle 1054 on Inquiry Card.

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Price: £250.
QBS Software Ltd., London, U.K., +44 181 956 8000; fax +44 181 956 8010; skye @qbss.co.uk; www.qbss.com.
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News & Views

VISUAL SQL

Turn Visual C++ into a full-blown Client/Server RAD Tool!

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- **Visual SQL Wizards** enhance the Visual C++ wizards and add new ones to automate & shorten every stage of client/server development
- **MFC Extensions** add classes for advanced features such as datasheet displays, virtual lists, extensive formatting, etc
- **Sybase SQL** Anywhere (included) enables most of the development to be done on a single machine

Visual SQL is currently available at a 90-day special introductory price of £725, so call us now if you want to develop client/server apps quickly.

OPTIMA++ DEVELOPER

The First Variant of Powersoft's New RAD C++ Tool is Now Available at a Very Special Introductory Price!

We now have more details about Powersoft's new C++/Java Tool:

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- **Optima++ Professional** (3Q) adds support for building components, Internet development (Java applets and CGI, NSAPI & ISAPI apps), PowerBuilder tools (DataWindow, DataPipeline & InfoMaker), and a 3-user Sybase SQL Anywhere
- **Optima++ Enterprise** (3Q) adds native drivers for Sybase, Oracle, DB2, Informix & SQL Server, and ObjectCycle, Powersoft's new server-based object repository with versioning, labeling & reporting

Optima++ Developer is currently available for less than half its retail price, and it includes a rebate against the Professional & Enterprise when they are released in the 3rd Quarter - call us for full details!

OBERON DIRECT-TO-COM

OLE/COM Made Simple & Safe!

There is no space to do justice to this innovative new product (finalist in BYTE Best Products at CeBIT'96), so you will have to call us for more details if you are serious about OLE/COM development and want to use a modern type-safe object-oriented language. The price of £1700 may seem rather steep, but those writing COM objects in C++ may think it's a bargain!

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BeBox combines powerful, inexpensive hardware with a state-of-the-art multithreaded OS. **By Raymond GA Côté**

The New OS in the Blue Box

BeBox and Be OS less than $3000
(a "full" configuration is yet to be determined)

Be, Inc.
Menlo Park, CA

(415) 462-4141
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BeBox, with its multiple threads and database objects, is tailor-made for multimedia development.

The BeBox hardware and Be OS software from Be, Inc. make an impressive system—modern, fast, and inexpensive. Inside the blue BeBox sit twin 66-MHz PowerPC 603s—the hardware underpinnings for the multiple threads and database objects that make BeBox a potentially great platform for multimedia development. The motherboard supports industry standards, such as a PCI/ISA expansion bus, an ATA IDE connector, and built-in fast SCSI-2. Using off-the-shelf components is part of the company's strategy to combine high performance with affordability.

We tested BeBox in a beta version with developer release 7 of the Be OS and the first release of Metrowerks' *native* CodeWarrior C++ development environment. Be bundles a Lite version of CodeWarrior with BeBox; it generates executable files of up to 64 KB only.

BeBox can hold up to 256 MB of RAM, a floppy drive, two internal hard drives, and two 5¼-inch drive devices. It takes standard PCI graphics cards (assuming Be-specific drivers), such as Number Nine's GXE64. BeBox also provides a plethora of ports, including two MIDI, four serial, two joystick, three infrared controller, and audio ports. Unique is the 37-pin GeekPort (see the Tech Focus).

The new OS is an exciting implementation of object-oriented OS concepts (see "The Be-All of Operating Systems," May BYTE). Based on a microkernel design, the OS is composed of multiple servers and software kits. Servers provide such basic functionality as file I/O and, our favorite, a built-in relational database. With just a few lines of code, you can create structured data storage for passing complex information between applications, remembering references, or keeping information important to a particular run of an application. Software kits provide an object-oriented API to the servers and add their own functionality.

BeBox is a programmer's dream, but the average user will find the user interface (UI) a bit rough and inconsistent. For example, inserting a disc in the CD-ROM drive does not make it immediately available for use. Instead, you must select Mount All Disks from a menu.

Although we didn't run formal benchmark tests on BeBox, we were pleased with the overall responsiveness of the multithreaded UI. We don't know yet what the final market will be for Be's new system, but we'd much rather develop custom applications on BeBox than on a Unix box. ◼

RATINGS	
TECHNOLOGY	★★★★★
IMPLEMENTATION	★★★★

TECH FOCUS

Dreaming in GeekPort

BeBox's GeekPort, a do-it-yourself port for taking in digital or analog signals and controlling external devices, uses a standard 37-pin D connector. It provides:

- **Two 8-bit bidirectional data ports, independently configurable (16 inputs, eight inputs and eight outputs, or 16 outputs)**
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- **Four D/A pins, each connected to an independent 8-bit D/A converter; an analog-signal ground reference pin is provided**
- **11 power and ground pins (two at +5 V, one at +12 V and −12 V, and seven grounds)**

Raymond GA Côté is a BYTE consulting editor and vice president of product development for Appropriate Solutions, Inc. You can reach him on the Internet at **rgacote@apsol.com.**

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★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Eva

Web Development Tool

Next's cross-platform middleware technology provides a promising infrastructure for creating dynamic Web applications. ***By Rohit Khare***

The Next Big Thing on the Web

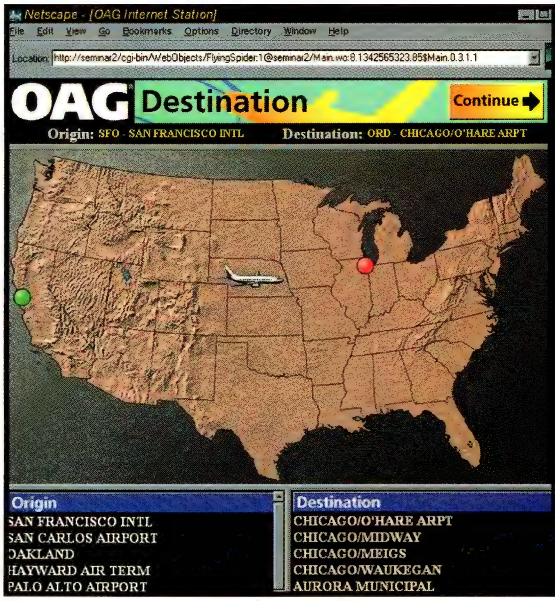
Six years ago, the power of Next's operating environment and user interface inspired Tim Berners-Lee to prototype a networked hypermedia browser/editor that later became the World Wide Web. Today, Next Software aims to spark a new generation of dynamic Web applications based on WebObjects, the company's new cross-platform middleware technology.

WebObjects advances the state of the art by supporting large, "real" applications that require long-lived user sessions, transaction management, and database access. It's browser- and OS-independent, works with industry-standard data sources, and can use existing languages, such as C, C++, and Perl.

WebObjects simulates a client/server connection between the user and application objects on the server over connectionless HTTP transactions; it accomplishes this by automating session and state management. WebObjects handles the housekeeping to let remote Web clients appear to talk directly to application objects at the server. It also hides the complexity of breaking up a directly connected user interface into a series of separate Web pages and HTTP transactions. Furthermore, objects at the server have rich access to databases and legacy systems and are programmable.

There are three different editions of WebObjects: a free one that allows interpreted scripts; WebObjects Pro, which adds relational database access, remote messaging through Next's Distributed Objects and Distributed OLE (D'OLE), and compiled C, C++, and Objective-C code; and WebObjects Enterprise, which adds a scalable three-tier database framework for object-oriented access to legacy applications.

All this machinery buys exceptional agility for repurposing existing systems.



Location: http://seminar2/cgi-bin/WebObjects/FlyingSpider:1@seminar2/Main.wo:8.1342565323.85$Main.0.3.1.1

Origin: SFO - SAN FRANCISCO INTL Destination: ORD - CHICAGO/O'HARE ARPT

Origin	Destination
SAN FRANCISCO INTL	CHICAGO/O'HARE ARPT
SAN CARLOS AIRPORT	CHICAGO/MIDWAY
OAKLAND	CHICAGO/MEIGS
HAYWARD AIR TERM	CHICAGO/WAUKEGAN
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This Web interface to a mainframe-based airline guide was prepared in about a week with WebObjects.

For example, the Web version of The Official Airline Guide (OAG), a mainframe-based flight-selection and purchasing application that integrates several other massive reservation systems, was prepared with WebObjects Enterprise and Conextions' 3270Builder screen-scraper in about a week (see the screen above).

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★

Still, this is a version 1.0 product, and it leaves much room for such improvements as more sophisticated interface handling, including visual HTML layout tools. However, Next plans to add these features in a WebObjects upgrade planned for release later this year. For the time being, third parties have stepped in to provide visualization tools and widgets, including Lighthouse Design's WebVision graphing and charting package.

Because it's so new, WebObjects ships with few out-of-the-box applications. We also found its interpreted scripting language, called WebScript, to be slow.

Since WebObjects only emits HTML, it can already embed Java applets or ActiveX controls, such as the U.S. map in another OAG screen not shown. The map is a Java applet that animates a plane flying across a user-selected route.

The Web is becoming a universal platform for running applications on intranets and on the Internet. As one of the first industrial-strength development kits for weaving such applications into your Web efforts, WebObjects is well worth a look. **B**

Rohit Khare is on the technical staff of the World Wide Web consortium in Cambridge, Massachusetts. You can contact him by sending e-mail to **khare@w3.org**.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

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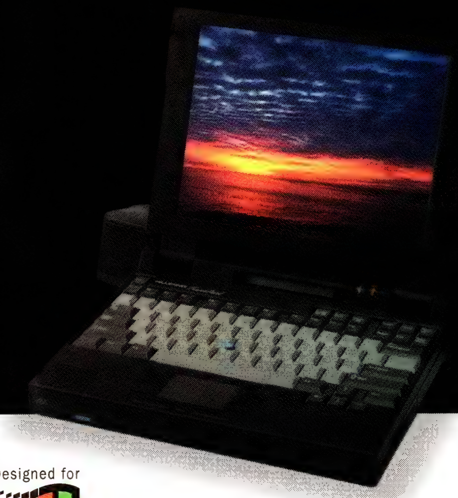

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Eva

Chinese Handwriting Recognizer

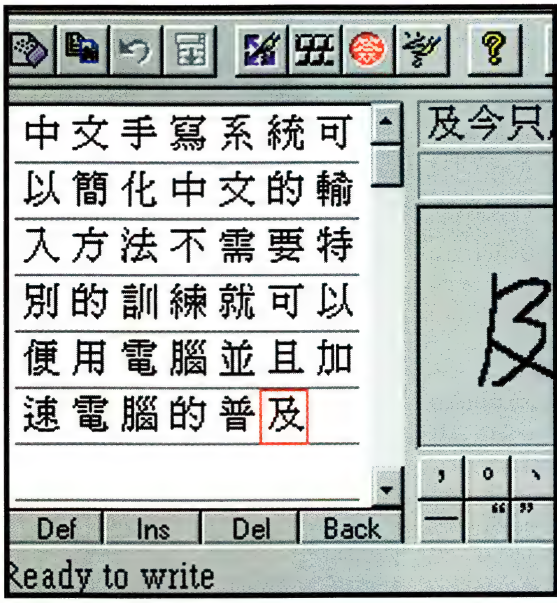
When you consider the challenge of recognizing alphabetic handwriting, Lexicus's achievement with Chinese is remarkable. **By William Zhao**

Solving the Chinese Puzzle

While most native English speakers are used to the layout of a keyboard, most Asians aren't even familiar with the *concept* of a keyboard. This has effectively locked out a large population from the computer age entirely, especially in Chinese-speaking countries, where typing is a foreign notion.

To help tackle this problem, Motorola's Lexicus Division is introducing a Chinese handwriting recognizer called WisdomPen. Lexicus has attempted to address three common problems: recognition speed, accuracy, and an inability to recognize cursive writing of Chinese characters.

We tested a beta version of WisdomPen on a 486DX4/100 notebook that had 24 MB of memory, using a Wacom ArtPad digitizing tablet for input. Lexicus designed the software to run under the Chinese version of Windows 95. However, even with the necessary conversion middleware, it seems to run at an astonishing speed in the U.S. version.



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The ultimate GUI, WisdomPen uses icons to pick commands for recognizing characters in a pictographic language.

The problem of misreading handwriting is particularly acute with Chinese. It has over 3000 characters in daily use—twice that number when you consider older texts and unusual names—and many are quite similar in structure. Figuring that business letters wouldn't present much of a challenge to WisdomPen, we started copying sentences from a book that was written 2000 years ago. This text contains many words seldom found in business. Out of the first 30 characters we copied, the recognizer misread only two, and it recognized some of the most complicated characters in Chinese.

TECH FOCUS

Which Character Was That?

Because many Chinese characters are similar in structure, WisdomPen uses the physical act of handwriting to aid the recognition process. It notes the order of the strokes, an important clue in the logic of character recognition. This is a tremendous step forward compared to most other Chinese pen-recognition software, and it contributes to WisdomPen's high accuracy.

We had some trouble reading characters that are similar to one another in both structure and stroke order. However, the system lets you correct mistakes by providing a list of other likely characters to choose from.

With the beta version, we had to input characters into two fixed boxes. The software read each character within several seconds of our lifting the pen from the tablet or upon our moving the cursor outside the input box. You can adjust the speed of character reading in the setup routine.

The shipping version will offer greater freedom in that you will be able to write anywhere on the tablet. This will let you copy texts continuously, without interruption. Unlike English and most Western languages, Chinese rarely links characters together. Therefore, the software can always process each character separately. The system also lists the most probable *next* character. This feature worked well for business letters.

RATINGS

TECHNOLOGY	★ ★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

Lexicus plans to market WisdomPen first in Asia/Pacific Chinese-speaking countries. The package will include a digitizer and a pen. **B**

William Zhao is with Hewlett-Packard in Chelmsford, Massachusetts. You can contact him on the Internet at **William_Zhao@HP-Chelmsford-om1.om.hp.com.**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Palm Pilot PDA

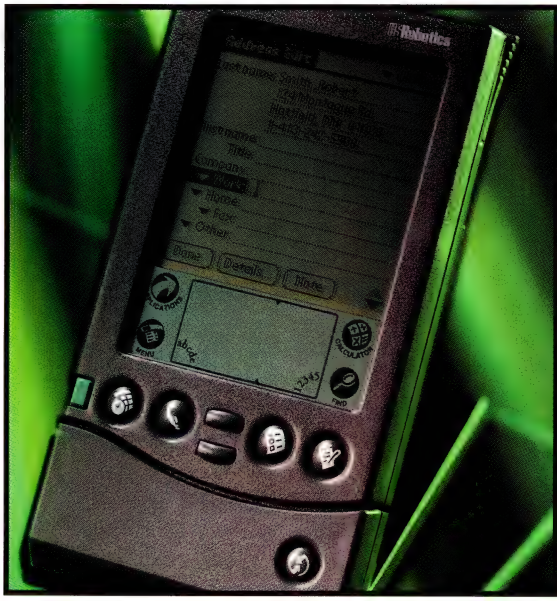
This simple personal organizer proves that even with computers, less is more—if it's done right. **By Peter Wayner**

PDA Packs Power in Your Pocket

In the world of desktop computers, the buzzword has long been "more"—more graphics, more speed, more RAM. So it's something of a surprise that U.S. Robotics has created such a likable PDA by giving people so much less. About the size of a stack of 3- by 5-inch index cards and weighing less than 6 ounces, the Palm Pilot does a great job keeping track of names, notes, numbers, and schedules. That's it.

More important, the Pilot solves the PDA-to-PC data-sharing problem that has limited the usefulness of other PDAs. It comes with a cradle that connects to your IBM-compatible PC's serial port, plus Windows organizer software that replicates the PDA functions. You drop the Pilot into the cradle and press one button to synchronize the two databases.

Other PDAs offer more, but they weigh more, too. Apple's Newton and Sony's MagicLink have a PC Card slot, and Motorola's Envoy sports wireless messaging. The Newton has handwriting recognition, and the MagicLink has Telescript. All have bigger screens than the Pilot's 160 by 160 pixels. But none of them can hide in a shirt pocket, and that's still the most beguiling thing about the handy Palm Pilot.



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When it's not in your pocket or your hand, the Pilot resides in a cradle connected to your PC.

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TECH FOCUS

The Handwriting on the Screen

The Pilot uses Palm's Graffiti software to read letters you input with a stylus. Graffiti forces you to write letters its way. For instance, an A is written with two strokes and no crossbar like an upside-down V. The designers restricted the alphabet to save writing time and to increase the differences between letters. The system isn't foolproof, but it's a significant advance over the old technology. It takes some time to learn, but the speed is worth it. Humans are just easier to train than computers.

The Pilot's software is well designed, with a spare and consistent interface. There are four major applications—for keeping a date book, recording notes, maintaining an address file, and keeping track of things to do—and you get to them instantly by pressing one of four tiny buttons on the bottom of the Pilot. Although the applications are simple, we couldn't find any major limitations. The date book starts off labeling each day's time slots from 8 a.m. to 6 p.m., a potential problem for night owls, but you can modify this with the preferences menu.

All four applications accept input through the Graffiti pen system or via a tiny on-screen keyboard you tap with the stylus. We think the ability to navigate with a stylus is a big innovation. Some people may still enjoy stroking keys, but the simulation of paper and pencil made operation feel more natural to us.

The processor is a Motorola M68328, a low-power member of the 68K family. Palm claims the battery life of the Pilot's two AAA cells is 8 to 12 weeks.

The Pilot's basic goal is not to bundle your PC in your hand—it's to automate your pocket notebook. There may be more applications in the future, because Metrowerks plans to produce development tools for the system. For now, though, the Pilot is just an automatic black book. There's not much to it, but that's precisely the point. B

RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

Peter Wayner is a BYTE consulting editor who lives in Baltimore. You can reach him at **pcw@access.digex.net.**

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

Developing OpenDoc components gives you OLE interoperability for free: You can have your cake and eat it, too. ***By Emily A. Vander Veer***

OpenDoc Says OLE to Developers

OpenDoc is a software component technology (see "A Close-Up of OpenDoc," March 1994 BYTE). Any discussion of OpenDoc provokes comparisons with Microsoft's OLE technology, which was designed to facilitate the exchange of data between Windows applications.

OpenDoc was designed to be open—not only in terms of platform independence, but also in its ability to interoperate with other compound-document architectures, such as OLE. Because OpenDoc allows access to all the services that OLE provides as well as offering additional functions, it presents a superset of OLE.

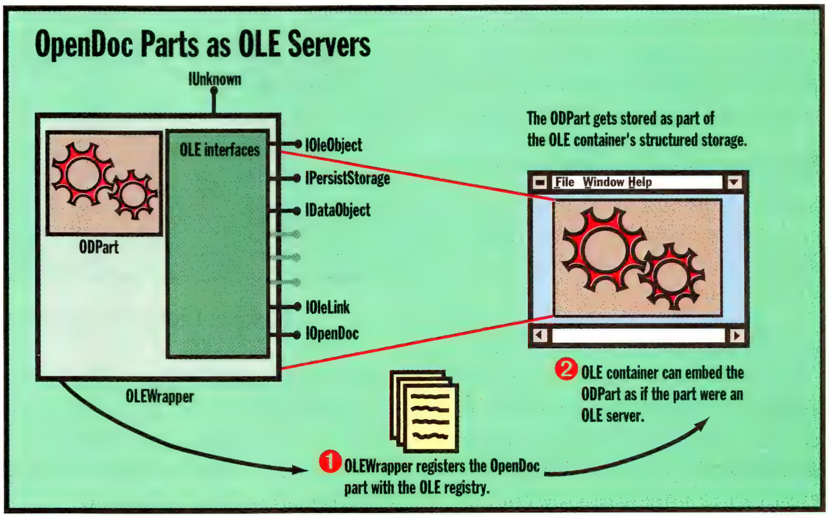
An OpenDoc part can be contained in or linked to an OLE container, and an OpenDoc container can contain or be linked to an OLE server application. This interoperability applies on every platform where both technologies exist, including OS/2 and Windows. The Windows version of OpenDoc was not generally available at this writing, and the design outlined here may change somewhat before the code ships later this year.

With both OS/2 and Windows, OpenDoc provides wrapper components that intercept and reroute method calls between containers and their embedded components (see the figure "OpenDoc Parts as OLE Servers" above). Scripting is supported by mapping OLE Automation to OpenDoc's Open Scripting Architecture implementation and providing extensions where direct mappings are inappropriate.

There are differences between the OS/2 and Windows implementations of OpenDoc. The OS/2 code contains additional functions that manage the communication between OpenDoc for Windows (Win-OS/2) and OS/2 and resolve platform differences. For example, interoperability calls on the Win-OS/2 implementation are replaced in OS/2 with Distributed System Object Model (DSOM) calls to OpenDoc for OS/2.

Registration and Run Time

OLE objects embedded in an OpenDoc container don't have to be explicitly registered with the OpenDoc shell; developers need only register their objects with OLE as they would normally. When an OLE object is detected, OpenDoc is informed via the OLE object's component wrapper (which is discussed in detail below). This wrapper queries the OLE registry to obtain the OLE-server executable name corresponding to the appropriate OLE class ID.


OpenDoc Parts as OLE Servers
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IOleObject
IPersistStorage
IDataObject
IOleLink
IOpenDoc
ODPart
OLEWrapper
The ODPart gets stored as part of the OLE container's structured storage.
File Window Help
② OLE container can embed the ODPart as if the part were an OLE server.
① OLEWrapper registers the OpenDoc part with the OLE registry.

OLEWrapper lets an OLE container embed an OpenDoc part.

Although OpenDoc parts developers don't need to write additional code to take advantage of OLE interoperability, they must register their OpenDoc parts with OLE. The registration process is managed by the ODRegisterClass API.

Required parameters for ODRegisterClass include a valid class ID value, which can be obtained either by invoking the utility UIDGEN.EXE or by contacting Microsoft; a human-readable part name; and icon information. The API adds the parameter information to a file that OpenDoc then accesses to identify the DLL associated with the part at run time.

ODRegisterClass also creates a temporary OLE registration file, which is merged into the OLE registration database via REGEDIT.EXE. As a result, OLE is able to recognize new data types associated with the OpenDoc document shell. This somewhat cumbersome process is likely to be streamlined prior to general availability of the OpenDoc for Windows implementation in the third quarter of this year.

Two wrapper components represent the bulk of the interoperability function. OLEPart enables OLE components to be embedded in OpenDoc documents, while OLEWrapper enables OpenDoc components to be embedded in any OLE container.

OLEPart is used to wrap an OpenDoc container so that it behaves like an OLE container; that is, it appears to OLE as a rectangular container that provides a single client site for any OLE object. OLEPart provides mappings for various OLE interfaces, such as IOleInPlaceFrame and IOleInPlaceUIWindow. OLE Control (OCX) interface support is also provided.

OLEWrapper is used to wrap OpenDoc parts so they appear as OLE servers. This is done by mapping all the interfaces that a well-behaved OLE server must implement to equivalent functions in the OpenDoc environment. In the current implementation, the OpenDoc document shell is executed once for every OpenDoc part embedded in an OLE container. This approach might be modified before the code is made generally available; while it provides crash protection between components, the performance of this design is slower than implementing a reentrant document shell.

OLEWrapper manages window creation and storage, menu and tool-space merging, and event notification between OLE and OpenDoc. OLEWrapper also provides IDropTarget and IDragSource interfaces for drag-and-drop support.

Interoperability Design Model

Several additional areas define interoperability between OLE and OpenDoc. These include data persistence, drag and drop, and linking.

Components access persistent storage through their native services; that is, method calls on storage objects are not intercepted by component wrappers. Thus, a container document defines a single persistent storage file, depending on whether it's an OpenDoc or OLE container. Within this single file reside all the container document's embedded components, each in turn stored in the storage-file type appropriate for that component.

For example, when an OLE server is saved as part of an OpenDoc container, the embedded OLE objects are saved as DocFiles, which are then included in their entirety in the OpenDoc container's persistent Bento document file. Likewise, an OpenDoc part typically saves its content in a storage unit in a Bento file. Embedded in an OLE container, the OpenDoc part still saves in a Bento format, but the Bento storage unit is in the embedding OLE container's DocFile.

<info on the www.>

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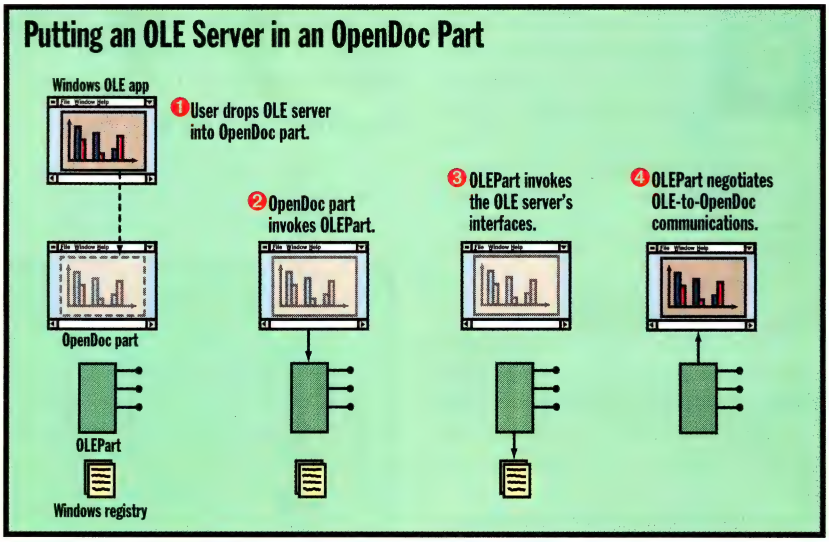
CI Labs–www.cilabs.org/
IBM–www.software.ibm.com/clubopendoc/index.html

Drag-and-drop interoperability permits OLE objects to be dragged and dropped into OpenDoc containers and vice versa. Drag and drop for OLE-wrapped OpenDoc objects maps the XMPDragDrop class in OpenDoc to the IDropSource object in Windows.

OLE and OpenDoc components can be linked together, with both sets able to act as target and source. To implement this, all link specifications in OpenDoc are managed by composite OLE monikers. This ensures unique monikers for each document as well as each contained component within a document.


Putting an OLE Server in an OpenDoc Part

Windows OLE app
① User drops OLE server into OpenDoc part.
② OpenDoc part invokes OLEPart.
③ OLEPart invokes the OLE server's interfaces.
④ OLEPart negotiates OLE-to-OpenDoc communications.
OpenDoc part
OLEPart
Windows registry

OLEPart lets an OpenDoc part embed an OLE server.

Good-Bye, OLE?

Code an OpenDoc part in OS/2 or Windows or on the Mac, and you have an OpenDoc part and an OLE component with no extra development effort or cost. So, if OpenDoc interoperates with OLE, why switch from OLE to OpenDoc?

The answer is twofold. First, OpenDoc/OLE interoperability is available only on those platforms where both OpenDoc and OLE exist. There are more platforms slated to support OpenDoc alone in the near future than there are platforms slated to support both technologies. Developers who write software for OpenDoc will be able to take advantage of all supported platforms.

Second, the learning curve for developers must be considered. Since both architectures interoperate, developers may choose one over the other based partially on how easily they can get their products to market. The number of APIs that must be implemented to develop a basic OpenDoc component is substantially less than the number required to develop a similar OLE component. As OpenDoc tools emerge, developers should find it even easier to develop cross-platform OpenDoc components.

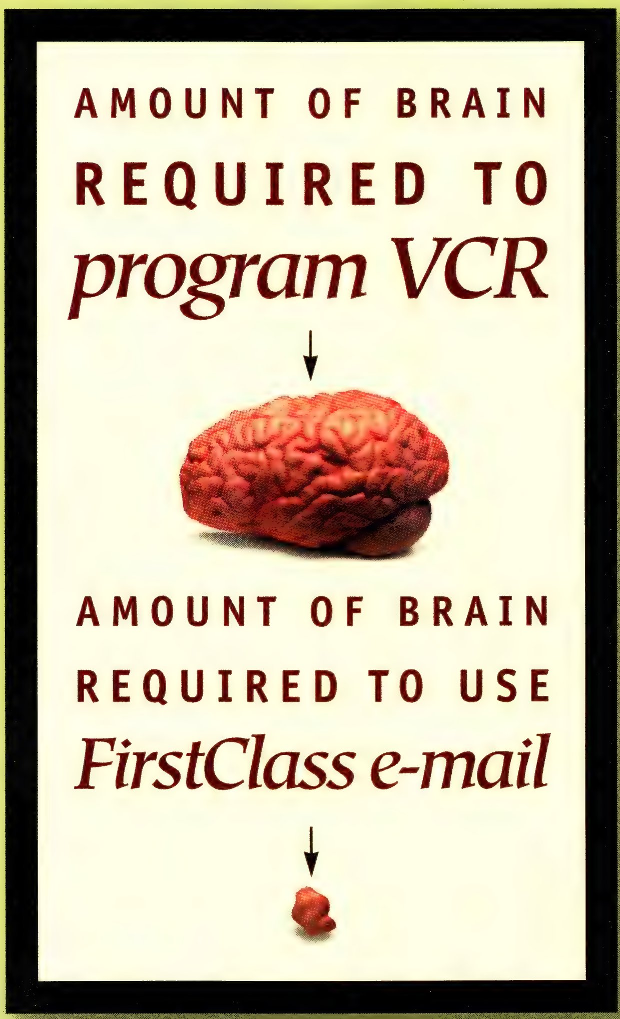
Basically, OpenDoc developers get something for nothing—well, almost nothing. Running nonnative software under an abstraction layer, such as OLEPart/OLEWrapper, always exacts some degree of performance penalty.

As with any new technology, leading-edge developers will have a steeper learning curve than those who enter the market-adoption phase after tools such as visual compilers and builders, wizards, and cross-platform tools become available. That's a price some developers are already paying to be among the first to exploit the power of OpenDoc in their commercial offerings. **B**

Acknowledgments

Stew Nickolas and Mark Rogalski provided technical details for this article. Stew is a senior programmer on the IBM OpenDoc team; Mark is the team lead for OpenDoc/OLE interoperability and the technical lead for Win-OS/2.

Emily A. Vander Veer has worked on object-oriented software development projects for five years. She is currently an IBM object-technology evangelist based in Austin, Texas. You can reach her at **emilyv@vnet.ibm.com**.



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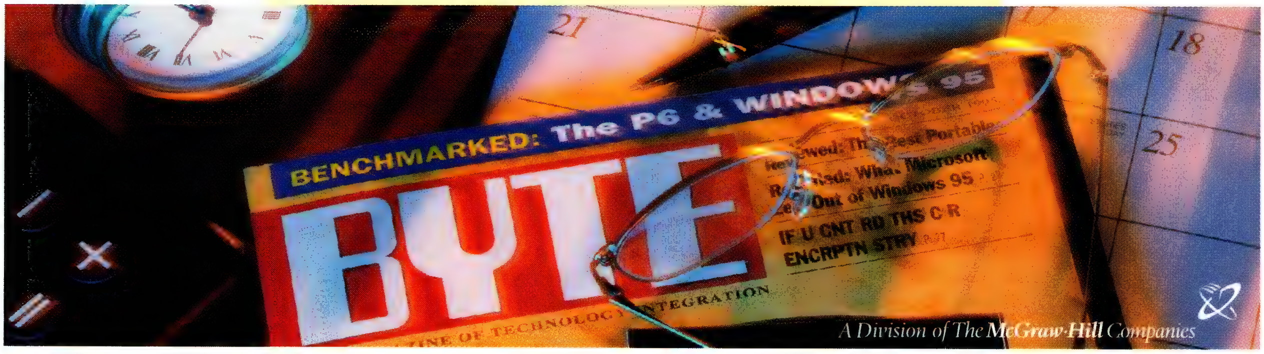

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New ways to carry LAN traffic over ATM solidify. ***By Salvatore Salamone***

Life in the Fast LANE

Many companies are beginning to migrate their traditional router-based networks to ones based on switching. Last year, revenues for switching products of all types grew by about 250 percent, according to the market-research firm International Data Corp. (IDC).

The driving force behind this shift is the need for more desktop bandwidth to support multimedia and other bandwidth-intensive applications. Switching offers an attractive way of delivering this bandwidth, for several reasons. The trick is to achieve this benefit while preserving some of the key features of routing.

One aspect that makes switching attractive is that it saves money because you retain your desktop investment. You can still use the same Ethernet or Token Ring adapter cards that have been sitting in your desktop systems all the while. You simply swap out your existing hubs and install switched hubs.

A second advantage to adding switching technology to a network is that everyone gets more bandwidth. Rather than all users on the same LAN segment sharing 4, 10, or 16 Mbps (depending on the type of LAN that they are connected to), each user can get up to the full segment of bandwidth dedicated to their connection.

Additionally, backbones that employ switching technology are easier to manage. That's because switches typically replace routers in such environments. And switches, which are essentially multiport bridges, are much easier to manage than routers.

But since switches are essentially multiport bridges, they do not typically perform routing at the network layer—something you might want to take advantage of. For example, you might want to contain traffic from applications running over chatty protocols to specific segments of a network. Or you might want to route between subnetworks.

ATM Steps Up

One way of deploying switching in an organization that seems to be taking hold is to use Ethernet or Token Ring switching in the workgroup and asynchronous transfer mode (ATM) switching in the backbone. This lets an organization retain its desktop environment and offers a switched, high-speed backbone.

Three Ways LANs Can Leverage ATM

Method	Advantages	Disadvantages
ATM APIs	Makes a direct connection between an application and ATM services, such as QoS.	Currently available APIs are proprietary.
LAN emulation	Lets you use the ATM backbone by converting IP packets to ATM frames.	Needs routers to handle traffic between subnets; does not support QoS.
Multi-Protocol over ATM (MPOA)	Specifies routing of IP and IPX for ATM switches, so no additional routers are needed.	No time frame for availability; some vendors are working on different implementations.

The drawback of using this combination is that truly taking advantage of ATM in such a situation requires some work. There are basically two issues to deal with: One has to do with the way packets are routed, and the other deals with gaining access to ATM services.

One approach to carrying LAN traffic over ATM is LAN emulation (LANE). With LANE, LAN packets are converted to ATM cells so they can pass over the backbone. LANE is pretty much the simplest way to merge LAN and ATM networks. The downside to LANE is that it requires routers to handle traffic that must pass between different subnetworks.

Often companies use switches and routers together, and the routers confine the traffic to portions of the network and let only the appropriate traffic pass to other subnetworks. A more interesting approach is to include the routing functions with the switch. A number of switch vendors' products allow you to sort and filter based on network-layer information within each packet. However, one limitation to such an approach is that you cannot take advantage of ATM's quality of service (QoS) feature.

Quality Is Job One

In a pure ATM network, QoS lets an administrator associate a QoS level with different types of traffic. The idea behind QoS is that you can give some types of traffic priority over other types.

For example, suppose you have a network that supports videoconferencing and large file transfers for an engineering group using CAD/CAM and also carries transaction-processing-based traffic from telemarketers taking phone orders from customers. If there are no priority levels, the engineers might clog the network when sending many files at once.

That wouldn't do wonders for the videoconferencing application, where delays produce noticeable jumps from frame to frame. And customers placing orders over the phone won't be happy if it takes the telemarketing folks a long time to confirm that each item is in stock. With QoS, a manager can set the levels so that the transaction-processing traffic gets the highest priority, the videoconferencing traffic the next-highest priority, and file transfer the lowest priority.

There are several ways to give traditional LAN applications access to ATM QoS features. But no one way is right for everyone. The most direct way is to write ATM APIs that directly link an application to ATM services. The main problem with ATM APIs is that they are proprietary and are often tied to the OS under which the application is running.

Ipsilon Networks, a start-up in Palo Alto, California, has come up with an interesting solution to the problem of getting LAN traffic over ATM and tapping ATM's strengths. The company has developed a routing protocol that delivers the features of traditional routing while leveraging ATM speeds.

Ipsilon sells a switch that runs the protocol. But other vendors will license the protocol from the company. Already, Ipsilon and Digital Equipment have announced a strategic technical alliance where Ipsilon's technology will be implemented on Digital's GIGAswitch/ATM switch and LAN switches.

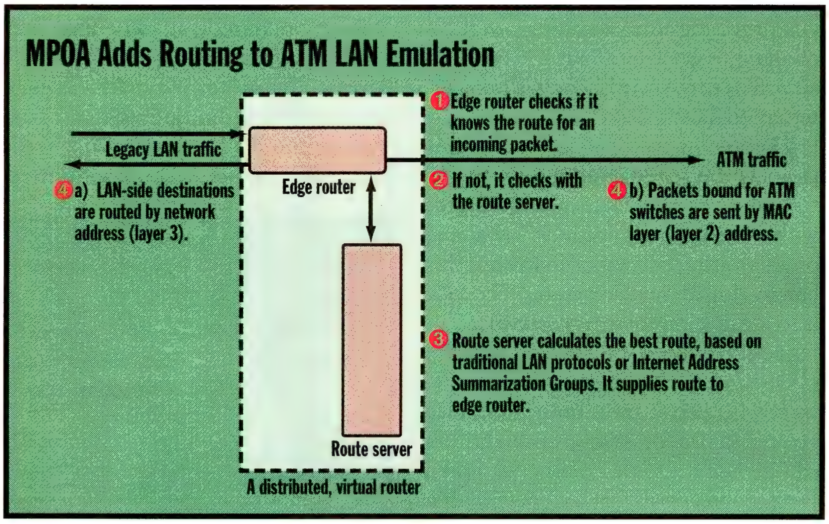
Ipsilon's approach is to put an IP stack on an ATM switch. The company's software uses an intelligent classification scheme whereby the switch dynamically determines when to switch and when to route. The determination is based on the nature of the traffic.

Traffic entering the switch is checked by an IP switch controller, the intelligent routing software. The IP switch controller performs what Ipsilon calls *flow classification*. The flow is defined as a sequence of like IP packets that are sent from one node to one destination address.

When longer-lasting flows, such as file transfers, multimedia traffic, and video streams, are noticed, the switch shifts into a cut-through switching mode of operation, where the switching is done in the ATM hardware. This is an efficient way to transfer the data between nodes. "The 'flow-labeled IP' approach gives you a blazingly fast router/switch combo," says analyst Ron Jeffries of Jeffries Research.

The Ipsilon architecture lets IP switches forward packets at speeds up to 5.3 million packets per second, according to the company. Short-lived traffic is moved using traditional store-and-forward techniques, where decisions are made using software. Basically, it's much slower to move data this way than by using cut-through, hardware-based switching.

MPOA Adds Routing to ATM LAN Emulation


Legacy LAN traffic
Edge router
Route server
A distributed, virtual router
ATM traffic
① Edge router checks if it knows the route for an incoming packet.
② If not, it checks with the route server.
③ Route server calculates the best route, based on traditional LAN protocols or Internet Address Summarization Groups. It supplies route to edge router.
④ a) LAN-side destinations are routed by network address (layer 3).
④ b) Packets bound for ATM switches are sent by MAC layer (layer 2) address.

The main disadvantage to Ipsilon's approach is that it's proprietary. But many industry analysts don't think this will deter users from taking advantage of the technology. "This is exactly what users are looking for," comments Fred McClimans, principal at Decisys, a consultancy based in Sterling, Virginia.

A secondary disadvantage to Ipsilon's approach is that the backbone must be IP-only. However, this is not a problem for many users. For example, 85 percent of Digital's installed customer base has pure IP backbones, according to William Maro, the company's vice president of network product engineering.

More Than One

For networks that have multiple protocols, there are other solutions. The ATM Forum has developed a specification called Multi-Protocol over ATM (MPOA), a routing protocol for ATM networks.

MPOA defines IP and IPX routing for ATM switches. Switches that run the protocol do not require separate routers in order to connect different subnetworks.

MPOA builds on the Forum's LAN emulation standard, which specifies at the media access control (MAC) layer (OSI layer 2) how legacy LAN protocols traverse ATM networks. MPOA adds layer 3 support and support for ATM's QoS.

The specification, expected to be completed later this year, has three components. First, there's edge devices that are LAN switches with ATM interfaces; they have software that processes packets at layer 3 but forwards packets at layer 2.

Next, route servers run traditional routing protocols, such as RIP (Routing Information Protocol) or OSPF (open shortest path first), and calculate routing paths. The route servers and edge devices split the functions of a traditional router.

The last component of MPOA is the Internet Address Summarization Groups, which are ranges of network-layer address groups. Here's how MPOA works: An edge device checks incoming packets. If a device receives a packet with a destination address that the edge device already knows, the packet is forwarded directly to the appropriate edge device. But if the edge device doesn't know the destination address, it must be looked up and the most appropriate route calculated before the packet is passed on.

ATM might eventually work its way all the way down to the desktop. But until it does, users must compromise with solutions such as MPOA or Ipsilon's when it comes to efficiently moving LAN traffic over ATM backbones. **B**

Salvatore Salamone is an editor at LAN Times. *You can contact him by sending e-mail to* **salvatore_salamone@wcmh.com**.

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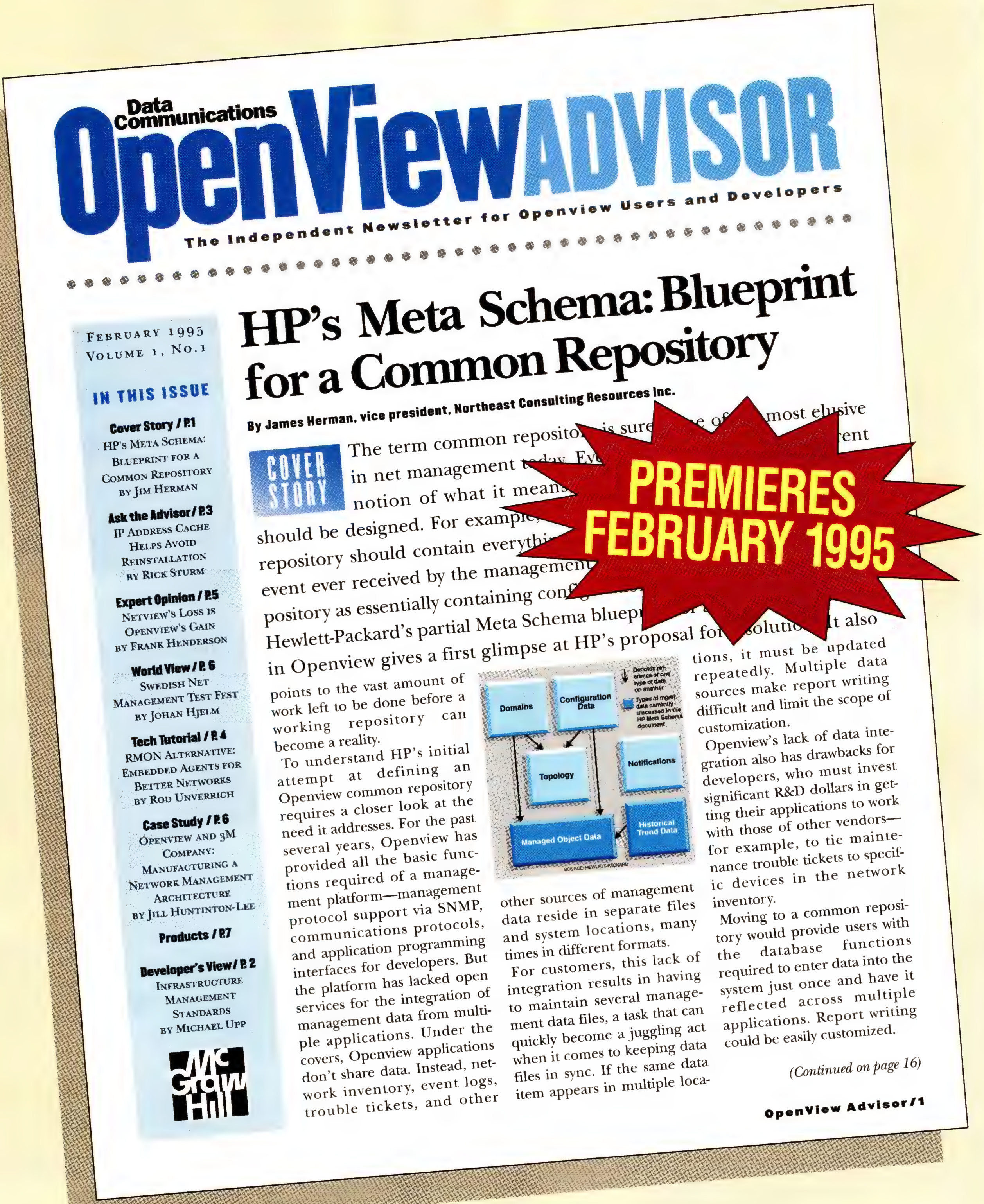

Data Communications
OpenView ADVISOR
The Independent Newsletter for Openview Users and Developers

February 1995
Volume 1, No. 1

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HP's Meta Schema: Blueprint for a Common Repository

By James Herman, vice president, Northeast Consulting Resources Inc.

COVER STORY

The term common reposito is sure e of most elusive in net management today. Ev ent notion of what it mean should be designed. For example repository should contain everythi event ever received by the management pository as essentially containing conf Hewlett-Packard's partial Meta Schema bluepr in Openview gives a first glimpse at HP's proposal for solutio It also points to the vast amount of work left to be done before a working repository can become a reality.

Domains
Configuration Data
Denotes reference of one type of data on another
Types of mgmt. data currently discussed in the HP Meta Schema document
Topology
Notifications
Managed Object Data
Historical Trend Data
SOURCE: HEWLETT-PACKARD

To understand HP's initial attempt at defining an Openview common repository requires a closer look at the need it addresses. For the past several years, Openview has provided all the basic functions required of a management platform—management protocol support via SNMP, communications protocols, and application programming interfaces for developers. But the platform has lacked open services for the integration of management data from multiple applications. Under the covers, Openview applications don't share data. Instead, network inventory, event logs, trouble tickets, and other other sources of management data reside in separate files and system locations, many times in different formats.

For customers, this lack of integration results in having to maintain several management data files, a task that can quickly become a juggling act when it comes to keeping data files in sync. If the same data item appears in multiple locations, it must be updated repeatedly. Multiple data sources make report writing difficult and limit the scope of customization.

Openview's lack of data integration also has drawbacks for developers, who must invest significant R&D dollars in getting their applications to work with those of other vendors—for example, to tie maintenance trouble tickets to specific devices in the network inventory.

Moving to a common repository would provide users with the database functions required to enter data into the system just once and have it reflected across multiple applications. Report writing could be easily customized.

(Continued on page 16)

PREMIERES FEBRUARY 1995

ndependent, objective source bout OpenView

Introducing the OpenView Advisor— from the editors of Data Communications

Corporate networkers who've made the move to OpenView know how tough it is to find the facts on the industry's leading net management framework. And the same goes for third-party developers looking to crack this lucrative market. Despite all its support, HP hardly qualifies as an impartial source, and surfing the Internet or searching computer magazines is no way to plan an effective enterprise management strategy.

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Intel's new MMX instructions bring faster multimedia processing to x86-compatible CPUs. **By Tom R. Halfhill**

x86 Enters the Multimedia Era

MMX is the most significant revision of the x86 architecture since Intel introduced the 32-bit 386 chip in 1985. Programmers get eight new registers and 57 new instructions that are optimized for multimedia tasks. Users will get better performance with video, graphics, animation, and sound. Yet the new MMX-enabled CPUs will be compatible with existing x86 software and should cost about the same as regular x86 processors without MMX technology.

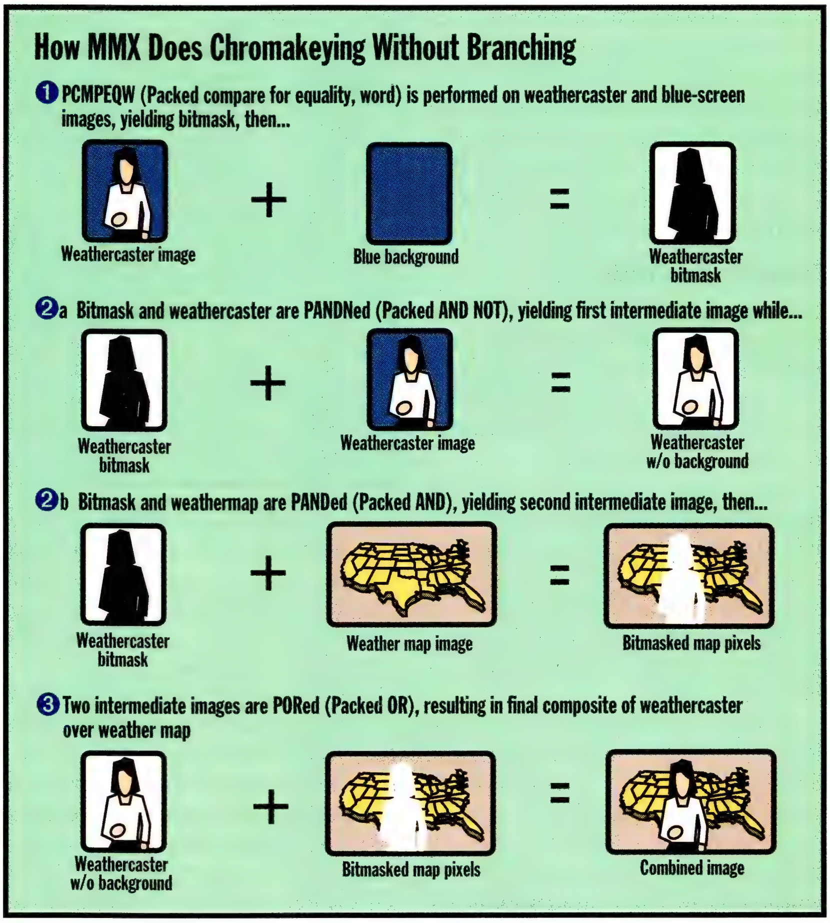
Intel says it will ship the first MMX Pentium (code-named the P55C) in the fourth quarter. Next year, Intel plans to integrate MMX into all its new x86 chips, including the sixth-generation Pentium Pro. By 1998, MMX will probably be as integral to the x86 architecture as the extended 32-bit instructions that Intel added to the 386 more than a decade ago.

Other x86 vendors are adopting MMX, too. Thanks to a recent cross-licensing agreement, future x86 processors from Advanced Micro Devices and AMD's subsidiary, NexGen, should be compatible with Intel's P55C. Cyrix, another x86 vendor, has not yet licensed MMX. However, Cyrix maintains that its future CPUs will be fully compatible with MMX, either by licensing or reverse-engineering the Intel technology.

Numerous software companies have announced support for MMX in upcoming versions of their products. These include key development tools such as Microsoft Visual C++, Watcom C++, Macromedia Director, and Criterion RenderWare. Microsoft says it will support MMX in its new Direct3D and ActiveMovie APIs.

Inside MMX

Adding new instructions to a microprocessor is easy: Define the new opcodes and add the necessary logic. But adding new instructions without disrupting software compatibility is another matter. It's a particular challenge with the x86 because backward compatibility isn't just advisable; it's mandatory.



How MMX Does Chromakeying Without Branching

❶ PCMPEQW (Packed compare for equality, word) is performed on weathercaster and blue-screen images, yielding bitmask, then...

❷a Bitmask and weathercaster are PANDNed (Packed AND NOT), yielding first intermediate image while...

❷b Bitmask and weathermap are PANDed (Packed AND), yielding second intermediate image, then...

❸ Two intermediate images are PORed (Packed OR), resulting in final composite of weathercaster over weather map

Complex multimedia processing can be done without code branches by using MMX instructions.

Intel mapped the eight new MMX registers into the existing stack of floating-point (FP) registers. There are eight general-purpose FP registers in an x86 FPU, and each one is 80 bits wide. FP values use 64 bits for the mantissa and 16 bits for the exponent. MMX instructions use those 80-bit registers as a random-access file (not a push-pull stack) of eight 64-bit registers. In other words, MMX instructions use only the 64-bit mantissa portion of an FP register to store MMX operands.

This trick gives programmers the virtual equivalent of eight new registers without radically altering the standard x86 architecture. OS vendors don't have to modify their code to save the state of

MMX registers during context switches—MMX registers look like ordinary FP registers to the OS. Clever, eh?

But there's a catch. Programmers can use MMX and FP instructions in the same program, but they'd better not mix them because both kinds of instructions need the same registers. When a program finishes a sequence of MMX instructions, it must clear the registers with a new instruction (EMMS: Empty MMX state) to make way for subsequent FP instructions. FP instructions do likewise when they pop values off the FP stack and set the registers' tag bits. If a program mixes FP and MMX instructions, it will pay a performance penalty for these register-level "context switches."

Generally, though, it shouldn't be a problem. Developers of multimedia should segregate MMX instructions in a subroutine or library that's called only after probing the chip's CPU_ID to verify that it supports MMX. It makes sense to group MMX instructions into tight routines, anyway, because multimedia processing typically involves repetitive operations on long sequences of data.

Packed Operands

Even though MMX instructions use FP registers, they're all integer-type instructions. Their 64-bit operands may contain eight packed bytes, four packed 16-bit words, two packed 32-bit doublewords, or a single 64-bit quadword.

Potentially, an MMX instruction could manipulate an 80-bit packed operand if it used a whole FP register. But Intel limited the operands to 64 bits because they match the Pentium's 64-bit I/O bus and internal data paths. Also, 80 isn't an even power of 2 in binary, so it's more troublesome to handle.

As it is, the 64-bit operands are plenty long enough for typical multimedia jobs. Suppose a program is manipulating graphics in 8-bit color, which is often the case in games. An MMX instruction can pack eight pixels into a single operand and process them all at once. An ordinary x86 CPU can shuffle only one pixel at a time. Audio and communications programs often use 16-bit data types, so a single MMX instruction can process four of those values in a single chunk.

Most MMX instructions follow this pattern of performing a single operation on a series of integer values. This technique is called single instruction, multiple data (SIMD), and it lends itself to the algorithms and data types frequently found in multimedia software. Examples include MPEG compression, wavelet compression, motion compensation, motion estimation, color space conversion, texture mapping, 2-D filtering, matrix multiplication, fast Fourier transforms, discrete cosine transforms, and phoneme matching.

What MMX Adds to Intel Instructions

Opcode Type	Mnemonic	Description
Arithmetic	PADD [B,W,D]	Packed add with wraparound on [byte, word, doubleword]
	PADDS [B,W]	Packed add signed with saturation on [byte, word]
	PADDUS [B,W]	Packed add unsigned with saturation on [byte,word]
	PSUB [B,W,D]	Packed subtract with wraparound on [byte, word, doubleword]
	PSUBS [B,W,]	Packed subtract signed with saturation on [byte,word]
	PSUBUS [B,W]	Packed subtract unsigned with saturation on [byte,word]
	PMULHW	Packed multiply high on words
	PMULLW	Packed multiply low on words
	PMADDWD	Packed multiply on words and add resulting pairs
Comparison	PCMPEQ [B,W,D]	Packed compare for equality [byte, word, doubleword]
	PCMPGT [B,W,D]	Packed compare greater than [byte, word, doubleword]
Conversion	PACKUSWB	Pack words into byte (unsigned saturation)
	PACKSS [WB,DW]	Pack [words into bytes, doublewords into words] signed with saturation
	PUNPCKH [BW,WD,DQ]	Unpack high-order [bytes, words, doublewords] from MMX register
	PUNCKL [BW,WD,DQ]	Unpack low-order [bytes, words, doublewords] from MMX register
Logical	PAND	Packed bitwise AND
	PANDN	Packed bitwise AND NOT
	POR	Packed bitwise OR
	PXOR	Packed bitwise XOR
Shift	PSLL [W,D,Q]	Packed shift left logical [word, doubleword, quadword] by MMX register or immediate value
	PSRL [W,D,Q]	Packed shift right logical [word, doubleword, quadword] by MMX register or immediate value
	PSRA [W,D]	Packed shift left arithmetic [word, doubleword] by MMX register or immediate value
Data transfer	MOV [D,Q,]	Move [doubleword, quadword] to or from MMX register
FP/MMX State	EMMS	Empty MMX state

Something else these processes have in common is a lot of potential parallelism. It's no coincidence that MMX instructions are integer operations; they're designed to exploit these characteristics. Like most other integer operations in a modern x86, the majority of MMX instructions can execute in a single cycle. MMX multiplication instructions require three cycles to execute, but the CPU can issue a new one every cycle.

Therefore, a superscalar CPU like the Pentium can execute multiple streams of MMX instructions in its parallel integer pipelines. An out-of-order CPU like the Pentium Pro can rearrange MMX instructions for maximum efficiency. The CPU doesn't need a special multimedia execution unit for MMX, so any advances that improve integer performance will benefit MMX performance as well.

One thing you won't find in the MMX instruction set is branch instructions. Branches would disrupt the instruction flow, and mispredicted branches would stall the pipelines—a particular hazard in the superpipelined Pentium Pro. Instead, there are new conditional-select instructions that perform logical operations on multiple operands. By using masks and bitwise comparisons, these instructions can achieve the same results as branches without the delays.

On balance, it appears that Intel has achieved its goal of updating the x86 to meet the demands of modern software without jeopardizing compatibility. Intel could have squeezed out more performance by making more radical changes—for example, by adding new MMX-specific registers instead of aliasing the FP stack—but such changes would slow down the adoption of MMX. The last time Intel extensively revised the x86 architecture was 11 years ago, and most PC users are only now making the transition to 32-bit software. Intel wants MMX to catch on a little faster. B

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Circle 82 on Inquiry Card.

A network diagnostics program for tracking down token-ring faults. ***By Barry Nance***

Diagnosing Token-Ring Ailments

Token-ring cards are a sociable lot: They say "hello" to each other many times during a day. They're health-conscious, too. If one card complains it's not feeling well, the other cards call for help. In comparison, Ethernet LANs fall silent when trouble strikes.

This article explains how to write software that listens for these cries for help on a token-ring network. The software will intercept, interpret, and display error-report packets so you can identify failing network components.

MAC-Layer Frames

Two basic types of frames circulate on a token-ring LAN. The first type carries information from a PC to a file server, or sometimes from one PC to another. These frames comprise the vast majority of LAN traffic.

The other type of frame on a token-ring LAN exists solely to help the network manage itself. Token-ring cards send and receive such frames—called MAC-layer (media access control) frames—without prompting from the network OS (NOS).

An active (i.e., inserted on the ring) token-ring adapter sends and receives MAC-layer frames entirely from within itself, without regard for the type of computer, OS, or NOS. The adapters communicate with each other every few seconds, interspersing their MAC-layer frames with the ordinary (NOS) "work-to-do" frames. The MAC-layer frames allow the adapters to tell each other who's in charge, who's present, who's merely coughing, and who's terminally ill. MAC-layer frames even let the adapters keep track of which adapters are ring neighbors.

Two token-ring devices are neighbors if they have adjacent connections at the multistation access unit (MAU). However, if some devices aren't presently ring members, their MAU ports don't count. You might, therefore, have two token-ring neighbors whose MAU ports aren't next to each other.

When a device transmits an error notification, the error is often the result of a garbled or missing transmission from the device's upstream neighbor, known as the nearest active upstream neighbor (NAUN). To fix blame for the error, you need to know the NAUN of the device signaling the error.

MAC-layer frames contain the fields that are shown in the figure "A Token-Ring Packet." The destination address and source address fields are 6 bytes on most networks. The data field varies in size from packet to packet and has a maximum length of approximately 4 KB on 4-Mbps LANs and approximately 17 KB on 16-Mbps LANs.

A frame that isn't a MAC-layer frame carries data in the data field (usually a file service packet, or perhaps an account ID and password during a log-in attempt). A MAC-layer frame, on the other hand, carries ring management information in the data field.

The 1-byte frame control field contains two subfields, Frame Type (the first 2 bits) and MAC Control ID (the remaining 6 bits). The 2 Frame Type bits have a value of 00 for MAC-layer frames and 01 for other frames (11 and 10 are reserved). The 6 MAC Control ID bits provide a general identification of the type of ring management frame.

Normal Frame Activity

About every 6 seconds, the network adapter that's designated the active monitor (which can be any adapter on the network but usually winds up being the adapter in the PC that's been powered on the longest) transmits an active monitor present frame, which is addressed to all other network adapters. The other network adapters chime in by transmitting standby monitor present frames, which indicate these adapters' ability to take over the role of active monitor if it becomes necessary.

If the adapters don't receive an active monitor present frame within several seconds, they broadcast claim token frames. They then negotiate with one another to decide which adapter will become the new active monitor.

A healthy token-ring LAN that's in a steady state—no one joining or leaving the ring—exhibits simple MAC-layer activity. When a token-ring-connected device joins or leaves the ring, the joining or leaving causes a brief electrical disruption of the ring. This disruption occurs as a relay inside the MAU closes or opens. The downstream device senses the disruption and transmits a soft-error-report (error-notification) frame.

A Token-Ring Packet

Fields	Bytes
Start delimiter	1
Frame control	1
Destination address	6
Source address	6
Frame data	?
Frame check sequence	4
End delimiter	1
Frame status	1

A token-ring packet's frame data field is variable-length, ranging up to 17 KB.

Typically, the downstream device categorizes the error as a burst error, line error, or token error. When a downstream device causes one of these errors by joining or leaving the ring, it's as if the ring suddenly sneezed. A healthy ring will experience burst, line, or token errors as the membership of the ring changes over time.

Abnormal Frames

A downstream device also uses the soft-error-report frame to notify other ring stations that a receiver-congestion error, an internal error, a lost-frame error, a frame-copied error, a frequency error, or an access control (A/C) error has occurred. Receiver-congestion errors may be a symptom of a failing network adapter or possibly a network adapter that simply can't keep up with the traffic flow. Receiver congestion happens when a token-ring adapter's input buffers are full and the adapter cannot accept an incoming frame.

An adapter that reports an internal error is trying to tell you that it may soon fail. An adapter notes a lost-frame error when the adapter fails to receive one of its own frames. A frame-copied error happens when an adapter recognizes a frame addressed to itself that another device has already recognized. Frequency errors usually signify serious cabling problems. Finally, an adapter reports an A/C error when the adapter receives a standby monitor present frame without first receiving an active monitor present frame.

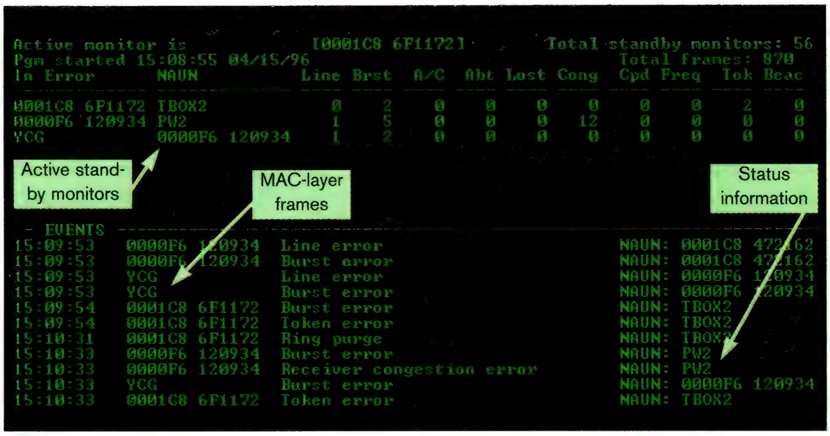
Beacon frames are a dreaded occurrence on a token-ring LAN. An adapter transmits beacon frames (it is said to be beaconing) to downstream devices when that adapter detects silence (no token or data frame) from its upstream neighbor. Hopefully, the adapter that's upstream of the beaconing adapter will receive the beacon alert. If the beaconing condition is the result of a momentary adapter fault, the adapter sensing the problem will eventually hear a signal from its upstream neighbor, and the ring will resume normal operation.

During the beaconing condition, the two adapters associated with the fault—the one beaconing and its upstream neighbor—remove themselves from the ring and attempt to reattach. If the condition is the result of a cable break, one or perhaps both of the adapters will fail to reattach, and the rest of the ring resumes normal operation. The result is usually a workstation or two dropping from the ring, and the other people on the LAN resume their normal work.

When a beaconing condition resolves itself successfully, people at most workstations will experience what seems to be a momentary pause in network access. (Of course, if a file server is involved in the fault and drops from the ring, everyone on the LAN may be affected.)

Using the Program

The token-ring monitoring program intercepts MAC-layer frames, decodes them, and displays the result. The top of the screen identifies the active monitor, shows the number of standby monitors, counts the number of MAC-layer frames that have been received, and lists the token-ring nodes that have reported errors. The bottom half of the screen displays MAC-layer frames as events, one by one. The program writes a log file of events and error statistics, appending to the file each time a token-ring device reports an error. The program updates the top half (the node list) of the screen every 6 seconds but shows events in the bottom half of the screen as they occur.



```
Active monitor is            [0001C8 6F1172]      Total standby monitors: 56
Pgm started 15:08:55 04/15/96                              Total frames: 870
In Error        NAUN              Line Brst  A/C  Abt Lost Cong  Cpd Freq  Tok Beac

0001C8 6F1172 TBOX2                  0    2    0    0    0    0    0    0    2    0
0000F6 120934 PW2                    1    5    0    0    0   12    0    0    0    0
YCG             0000F6 120934        1    2    0    0    0    0    0    0    0    0

 - EVENTS
15:09:53    0000F6 120934  Line error                           NAUN: 0001C8 472162
15:09:53    0000F6 120934  Burst error                          NAUN: 0001C8 472162
15:09:53    YCG            Line error                           NAUN: 0000F6 120934
15:09:53    YCG            Burst error                          NAUN: 0000F6 120934
15:09:54    0001C8 6F1172  Burst error                          NAUN: TBOX2
15:09:54    0001C8 6F1172  Token error                          NAUN: TBOX2
15:10:31    0001C8 6F1172  Ring purge                           NAUN: TBOX2
15:10:33    0000F6 120934  Burst error                          NAUN: PW2
15:10:33    0000F6 120934  Receiver congestion error            NAUN: PW2
15:10:33    YCG            Burst error                          NAUN: 0000F6 120934
15:10:33    0001C8 6F1172  Token error                          NAUN: TBOX2
```

Token-ring diagnostic software intercepts, interprets, and displays error-report packets.

The PC on which you run the diagnostic software must use the IBM LAN Support Program (DXMA0MOD.SYS and DXMC0MOD.SYS device drivers) or an equivalent. When the program begins to run, it looks for a file named USER.LST and, if the file is present, loads workstation node addresses and log-on names into memory.

You can create a USER.LST file for your LAN, if your NOS is NetWare, simply by running the USERLIST NetWare utility. Use the /a command-line parameter to cause USERLIST to show node addresses in the utility's output and redirect the output to a file with the ">" redirection character. If you use a NOS other than NetWare, a sample USER.LST file accompanies the software.

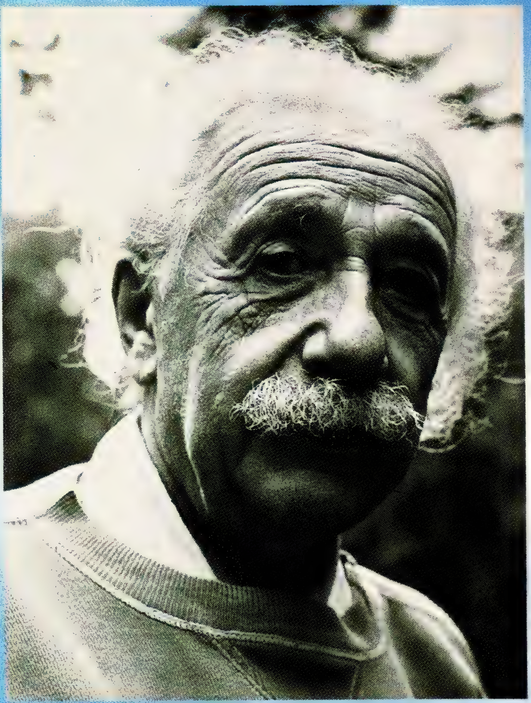
When the diagnostic program shows errors on the ring, you should note the node address or log-on name of the node reporting the error and of the NAUN. These pieces of information, along with the error message and the information in this article, should help you locate the problem.

The program clears the statistical error counts for a node that hasn't reported a problem in over 10 minutes. This means you'll see entries disappear from the screen as time passes and the network operates normally. However, the log file TOKENRNG.LOG will contain all the events and statistical error counts when you stop the program.

Ring Out

I hope you find the software useful and, if you're a programmer, interesting and informative. Frankly, however, I hope the program displays absolutely nothing but an odometer count of incoming frames on your computer screen. Token-ring errors can be exciting, but it's not the sort of excitement I'd wish on anyone. (The token-ring analyzer program is available on the BYTE Site at www.byte. com.) **B**

Barry Nance is a BYTE consulting editor and has been a programmer for 25 years. He is the author of Using OS/2 Warp *(Que, 1994),* Introduction to Networking *(Que, 1994), and* Client/Server LAN Programming *(Que, 1994). You can reach him on the Internet at* **barryn@bix.com**.



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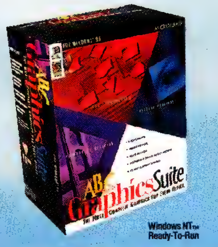

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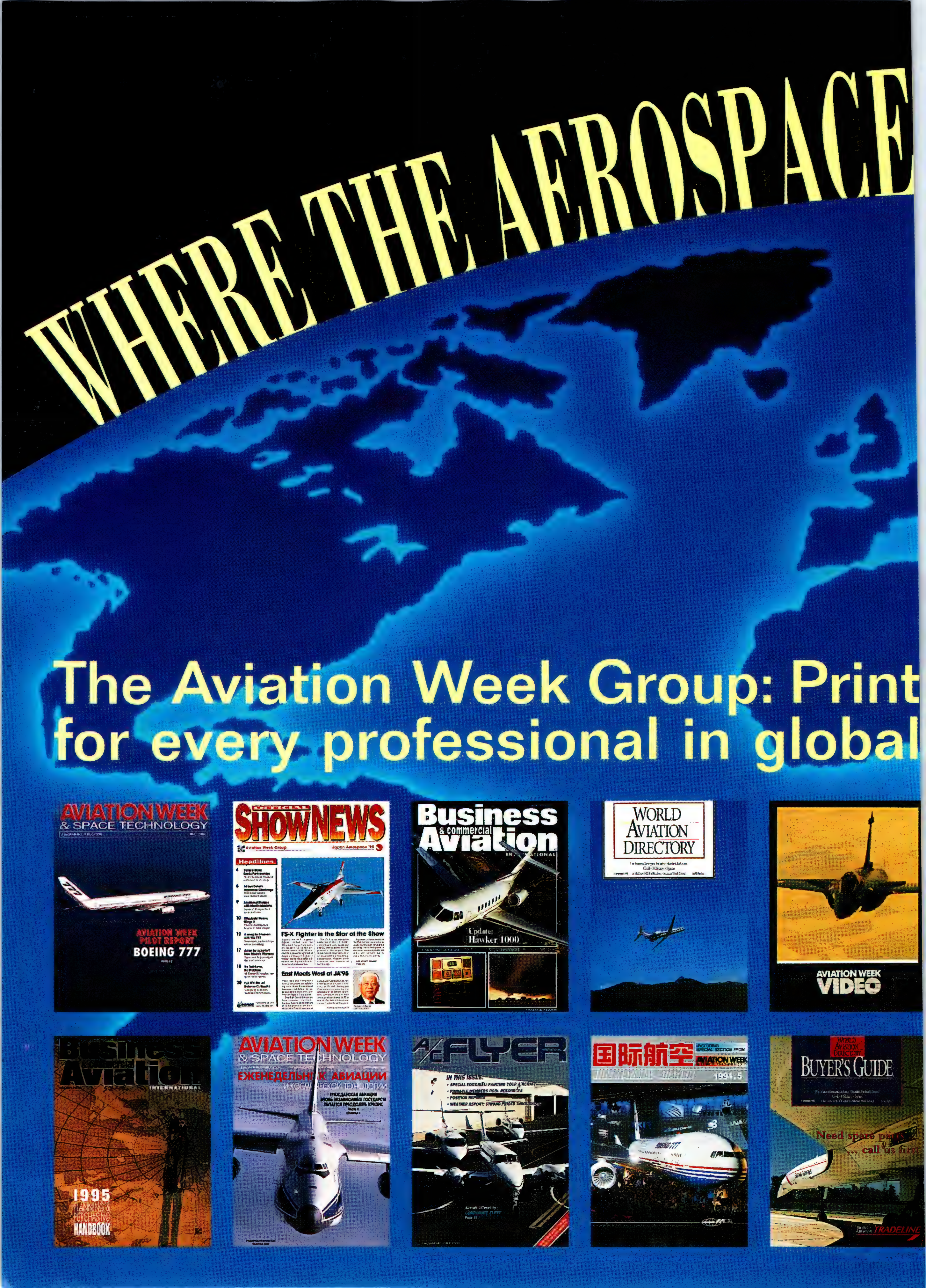
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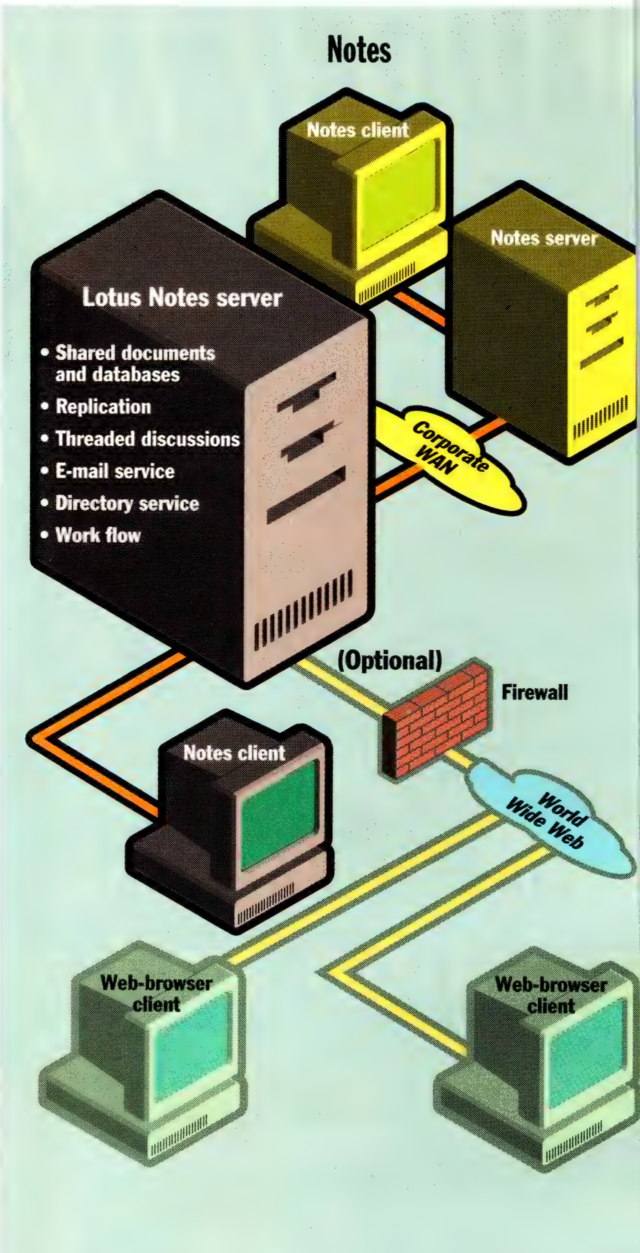
GROUPWAR STRATEGIES

Six key technologies will tell you if you need Notes **or** *the Web or Notes* **and** *the Web.*

By Bill Roberts



Advantages

- Integrated groupware components
- Supports Windows, Unix, Mac OS, and OS/2
- Real-world track record

Disadvantages

- No native RDBMS support
- Proprietary and complex
- Applications development tools are difficult to use
- Expensive

Notes versus the Web looks like something out of Mortal Kombat: intractable forces, fantastic weapons, a scorched-earth battle. Even if you're not in the thick of the fight, it's easy to get drawn into the conflict. On one side are Notes backers, who promise fully formed groupware in one neat package. On the other side are intranet proponents, who offer inexpensive Web-based intranets from multiple vendors for document sharing, conferencing, and other collaborative tasks.

Both sides claim victory will be theirs. But look beyond all the saber-rattling and consider the six essentials of successful groupware: standards, security, replication, applications development tools, object storehouses, and messaging models. How do Web-based technologies stack up against Notes?

The answer today is that intranet pioneers currently lag behind in most of these areas, but that may not be the case for long. For example, Netscape is rolling out SuiteSpot, a collection of five cross-platform servers and a development environment for intranets. There's also Digital Equipment's Workgroup Web Forum (recently renamed AltaVista Forum), the first of a set of open-standards groupware products. And Allaire is shipping development tools designed to build Web-based collaboration applets.

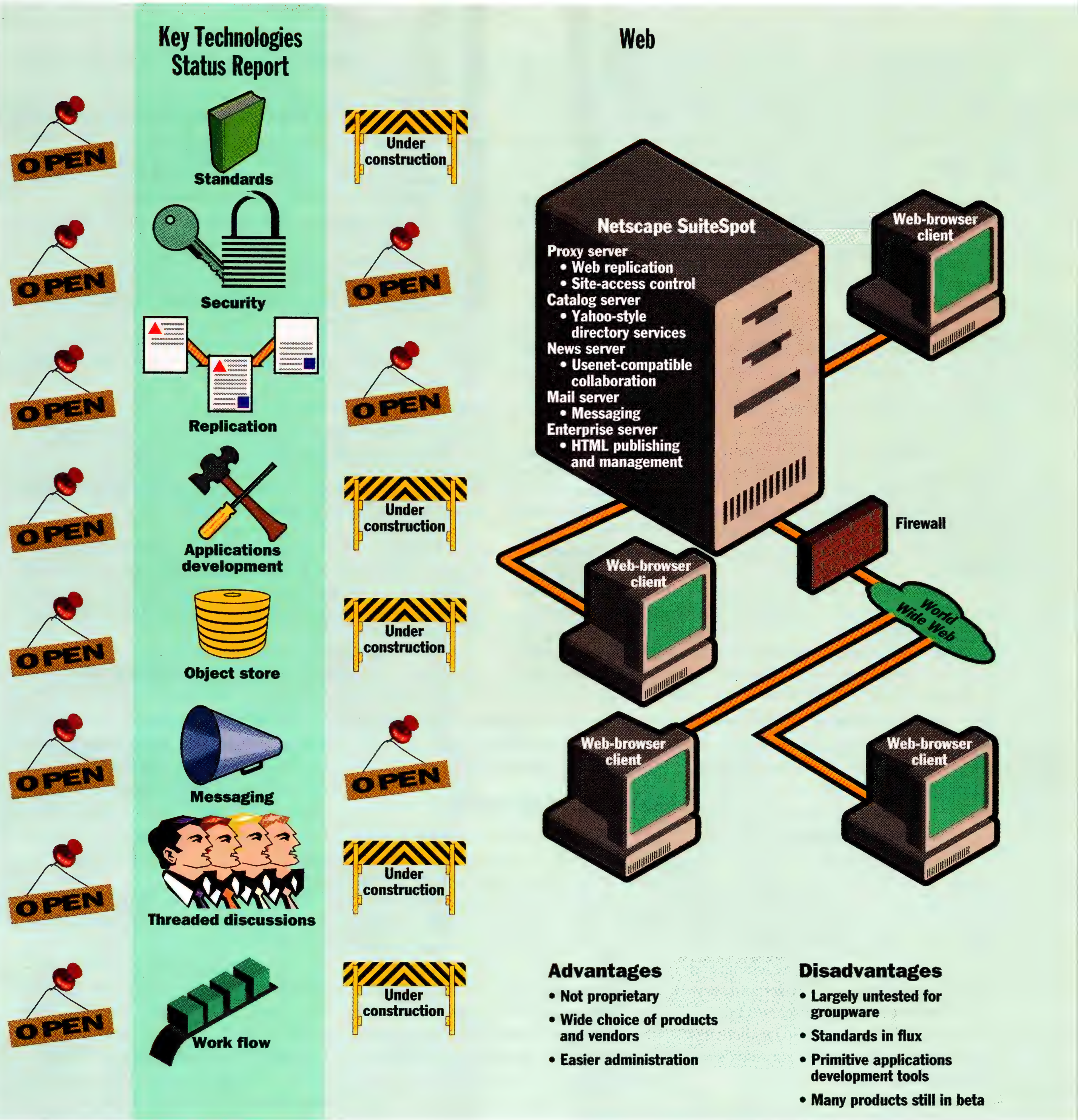
Other established vendors are integrating their products with the Web; examples include Lotus, Novell (with GroupWise), and ICL (with TeamWare). And, of course, there's the little matter of Microsoft Exchange (see the text box "Microsoft Exchange Server Needs Work: Yours" on page 70).

Within a year or so, expect a dozen groupware platforms, many niche applications, and maybe hundreds of applets for intranets. To decide where you should pledge your allegiance, you should examine the six essential groupware technology areas one by one.

The Standards Dance

One appeal of open-standards intranets is freedom of choice. Here's the dream: Choose applications from your groupware shopping list, buy the products that best suit your needs, slap

Two Views of Groupware



Advantages

- Not proprietary
- Wide choice of products and vendors
- Easier administration

Disadvantages

- Largely untested for groupware
- Standards in flux
- Primitive applications development tools
- Many products still in beta

them onto intranet servers, and—presto!—you have a seamlessly integrated groupware platform. But don't expect this dream to come true anytime soon.

Although the scattered pieces of Web-based groupware are beginning to appear, we're a long way from widely adopted standards that allow a mix-and-match system that works. Notes, the Swiss Army knife of groupware, already does just that.

Yes, it's proprietary. No, the source code is not in the public domain; you must license the software to get at the APIs to the platform. But Notes *is* interoperable: It's available on Windows, OS/2, the Mac OS, and Unix. It supports SPX, NetBIOS, AppleTalk, and Banyan Vines. Release 4 supports Internet protocols, including TCP/IP, SMTP, HTTP, and Hypertext Markup Language (HTML). Furthermore, Notes has an existing base of 3 million

Microsoft Exchange Server Needs Work: Yours

Microsoft Exchange Server comes during Microsoft's massive reorganization into Internet-aware business units. Positioning the product along the continuum between Lotus Notes and its Web-based groupware competitors requires a blend of analysis and prophecy.

While the shipping version of Exchange Server includes Notes-like features such as public folders, replication, and applications development tools, you need Microsoft's powerful Visual Basic 4.0 programming environment to match Notes' built-in prowess. Exchange's leveraging of Windows NT's administration capabilities makes the messaging platform a no-brainer for companies that are already focused on Windows, but Microsoft's success at integrating Web technology may prove crucial for cross-platform adoption.

Built on Mail

The Microsoft Exchange Client software builds on the Exchange Inbox included with Windows 95. Thanks to its extension of Microsoft Mail's shared-folders technology, everyone in an organization can now access public folders in addition to their personal folders. You can assign seven predefined levels of permission to users and groups, ranging from Contributor to Reviewer to several types of Author.

You can configure the Client to sort folder messages by author, date, keywords, or content type. Items can be grouped up to four levels deep by subject, importance, and other MAPI or OLE properties, and they can be filtered by the same–or different–criteria. Connecting to an Exchange Server allows the use of AutoAssistants that can process your Inbox and public folders for expected documents and then move or forward them based on rules.

The Exchange Client incorporates a client/server-enabled version of Microsoft Schedule+ 7.0; you can maintain appointments, tasks, events, and contacts, as well as schedule meetings, while sharing data with authorized users across the enterprise. Exchange Server supplies OLE Automation interfaces to both MAPI (i.e., OLE Messaging) and Schedule+ (i.e., OLE Scheduling), giving Visual Basic programmers powerful tools for integration with Microsoft Office and other OLE-enabled products.

Exchange makes it easy to create simple form and folder applications. Forms Designer uses a Form Template Wizard to help you choose between sending data to another user and posting to a public folder. The Forms Designer, a slimmed-down version of the Visual Basic interface, lets you add a limited selection of data-entry fields, option buttons, labels, and images to one or several tabbed windows.

When you save your work and launch the Install process, the Forms Designer compiles the form into modifiable Visual Basic source files and creates a run-time executable file. The EXE file installs in the organization forms library, a personal folder, or a designated public folder. In the Exchange Client's Properties dialog box, you use tabs to configure preferences. The Forms tab controls what types of items users can post, send, or drop in the folder. The Permissions tab grants user access. The Folder Assistant button in the Administration tab creates rules for processing incoming items.

Apps Made Not-So-Easy

Exchange provides several sample applications that you can use as-is or modify. Exchange's basic toolkit was used to build the Discussion & Response, Hot Topics, Contact Tracking, Document Filer, Interpersonal Forms, and Help Desk applications. Visual Basic programming was necessary for the Survey and Chess examples.

Adding custom controls not supplied by the Forms Designer requires the 16-bit version of Visual Basic 4.0. You can use data-bound controls to display, edit, and update records in an external database. Enhancing the intelligence of forms enables validating user input, performing calculations, and interacting with embedded OLE Controls (OCXes, now known as ActiveX controls).

There's no direct interface to stream ActiveX contents into a message. You have to write to a file and then use OLE Messaging functions to stream the binary data from the file to the appropriate control property

seats and 13,000 business partners that develop add-on products for the platform.

Imagine the chuckle that Notes folks must get out of watching Microsoft, Netscape, and Sun Microsystems slug it out to establish tool, API, and server standards. Here are just some of the protocols and standards that are not yet fully adopted: Secure Sockets Layer (SSL), Secure HTTP, HTTP-Next Generation (HTTP-NG, which includes caching, preemptive caching, and open sessions between browser and server), HTML 2.0 and 3.0, Netscape's Frames extension, and JavaScript. So far there has been little effort to set up standards for conferencing.

Developers and users will eventually sort out these issues. Yet even as that happens, Microsoft and Lotus are hoping to cash in on intranets by doing everything they can to adopt and support open standards without compromising their crown jewels. After integrating with the Web, Notes (currently) and Microsoft Exchange (soon) will make a strong run at dominating the intranet market. Throw in Netscape, and it's a three-horse race.

Balance of Security

To guard against misuse—accidental or premeditated—a groupware platform needs security that's rigorous enough to protect sensitive information yet flexible enough to let users assign access levels to documents. In a proprietary system, developers can adopt any security standard they want and invoke it throughout the product. That's what Notes developers did when they used Rivest-Shamir-Adleman (RSA) public-key encryption to build four levels of security: authentication, access control, field-level encryption, and digital signatures.

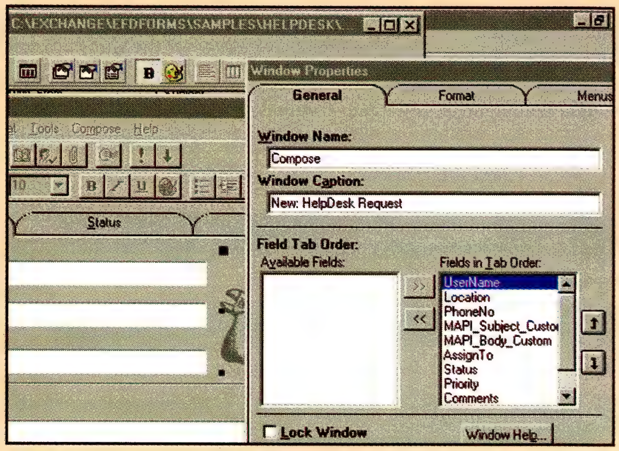
Notes' bidirectional authentication makes clients and servers identify themselves before they converse. Notes provides access control to servers, databases, documents, and document fields through a list of authorized users managed by whoever owns the resource. Field-level encryption lets you protect portions of a document. Notes even scrambles information so it can't be understood if an unauthorized person accesses it. Finally, digital signatures verify that the indicated sender actually sent the information the recipient receives.

Intranets, however, remain security-challenged. Buggy software and Common Gateway Interface (CGI) scripts, which abound on the Web, provide many security holes. A good firewall can protect an intranet from an outside invasion, but risks *within* the firewall include confidential documents that fall into unauthorized hands and private information that's intercepted on its way to the server.

Netscape has proposed the SSL protocol as a standard. SSL isn't universally supported, but it's gaining popularity at the server level. SSL secures the communications channel between client and server, in a layer above TCP/IP and below HTTP and other application protocols. The protocol offers bidirectional authentication, of the message. Forms Designer does not recognize changes you make with Visual Basic to a Forms Designer–generated form, and regenerating a form will overwrite your new Visual Basic code. You have to be careful to store new procedures in separate modules.

Tools Time

Microsoft has moved aggressively to integrate the Visual Basic development environment with the Internet and Web technologies. A toolkit of ActiveX custom controls already allows the incorporation of hooks to Web pages into Visual Basic–aware applications. Exchange already features an Internet Mail Connector with SMTP, Multipurpose Internet Mail Extensions (MIME), and X.400 support; however, Connectors for distributing Usenet news feeds to Exchange folders and translating public-folder contents into HTML will not ship initially.



Window Name: Compose

Window Caption: New: HelpDesk Request

Field Tab Order:

Available Fields:

Fields in Tab Order:
UserName
Location
PhoneNo
MAPI_Subject_Custo
MAPI_Body_Custom
AssignTo
Status
Priority
Comments

Exchange Server relies on Visual Basic 4.0 to compete with Notes as a complete groupware platform.

Contrast this to Notes 4.0's bundled InterNotes Publisher and Navigator tools, which allow bidirectional conversion between Notes and the Web. You can launch agents to download and convert Web pages and their uniform resource locator (URL) links to searchable Notes documents and then send newsletter summaries via e-mail for internal or Web publication.

Both Notes and Exchange can leverage the Internet to replicate data, dialing into a local Internet service provider (ISP) and connecting with TCP/IP. Exchange allows both server-to-server and client-to-server replication. The latter occurs when you create off-line replicas of your server-based public or private folders. Updating public folders with new versions of forms is transparent to the user, but you have to package custom controls and other executables separately and make them available to users.

Exchange's tight integration with Windows NT eliminates much housekeeping. You can use NT's User Manager for Domains to create user accounts and mailboxes simultaneously; existing NT and NetWare accounts can have mailboxes added automatically. NT's log-on, password management, and security-descriptor permissions models pass through to Exchange Server administrators.

The Microsoft Exchange product group provides server management tools, calendaring and scheduling functionality, and tight OS integration not yet found in Notes or Netscape's offerings. On the other hand, Notes' cross-platform capabilities now extend to the LotusScript programming environment, allowing custom applications to run on a variety of legacy systems. Notes 4.1 will update the product to support ActiveX custom controls, and a suite of Lotus Components includes modules for both calendaring and scheduling.

Microsoft's intention to merge its Internet Explorer with the Windows 95/NT 4.0 Workstation OS will continue to make 32-bit Windows the leading environment for Web development. While Lotus Notes has built up a big lead as the comprehensive groupware product, the legions of Visual Basic programmers represent heavy firepower as they turn their sights on Exchange and the Web. **–Steve Gillmor** is a consultant for groupware and other technologies. You can reach him by sending e-mail to 72662.3701 @compuserve.com.

message encryption, and message integrity.

SSL provides for optional client authentication. To achieve that, *client certificates*—also called digital IDs or digital certificates—must come from a certifying authority, such as VeriSign. The Netscape Proxy Server enhances security in three ways: with content filtering; by limiting access to documents, directories, or sites specified by uniform resource locator (URL) wild-card expressions; and through *reverse proxying*, representing a Web server to the public while the server remains behind the firewall.

Other proposed security protocols include Secure HTTP (SHTTP) from CommerceNet, a coalition of businesses developing commercial Internet projects. SHTTP is a high-level protocol that works only with the HTTP protocol but is potentially more extensible than SSL. At the present time, SHTTP protects the Open Market Marketplace Server, while Secure HTTP Mosaic, from Enterprise Integration Technologies, guards the client side. SHTTP and SSL complement each other.

Since these are only proposed standards, many developers are watching and waiting. "We're not currently using SSL. There is so much churn in the industry as to who will win," says Dave Griffin, a Digital team leader who is working on the company's Web-based groupware products. "We decided to stick with the least complicated, basic password security," he adds.

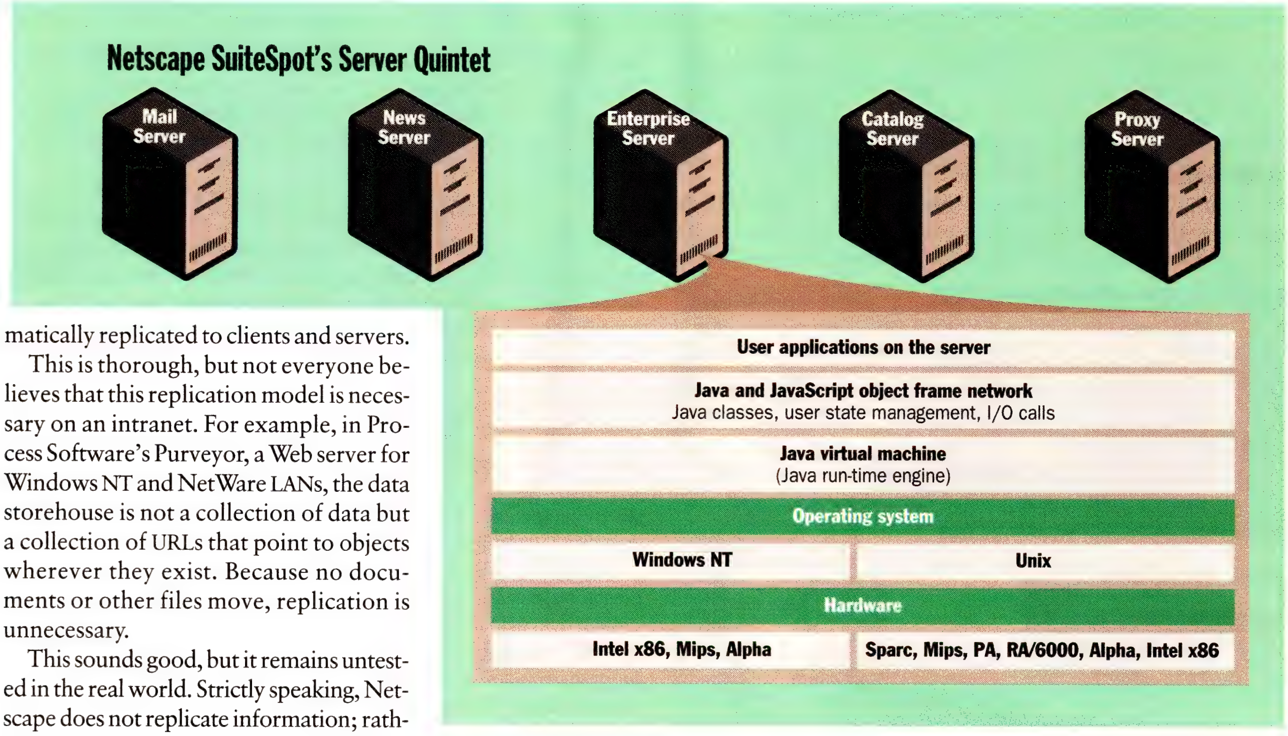
Replication Proliferation

Workgroups often include permanent or temporary employees located in scattered offices. Groupware must allow all team members to share information, despite the time or their location. It's vital for the platform to keep information synchronized and consistent across all sites.

Notes lets you keep multiple copies of single documents or databases, called *replicas*, on more than one server or desktop. By exchanging modifications among servers and clients, Notes makes all replicas identical over time.

Here's how it works. Notes assigns each database and each document a unique ID number. These 128-byte numbers include items such as time, location, and date. If a change occurs in a document, the "$LastUpdate" field changes to "Now." When server A and server B replicate, they compare their lists of ID numbers and ask, "When was the last time we replicated this number together?" They then ask each other for the list of all documents that have changed or have been added since the last replication. Then they exchange documents and update the databases.

Notes 4 offers a field-level replication feature, so only those fields that have changed or have been added replicate. Notes administrators usually set up automatic replication between servers. Replication between workstations usually takes place when a user tells the desktop to replicate with a server. Once a new application is on a Notes server, it replicates to any client or server that has appropriate access. Any changes to a program are auto-


Netscape SuiteSpot's Server Quintet

SuiteSpot consists of up to five Internet servers. The Enterprise Server acts as the applications hub.

matically replicated to clients and servers.

This is thorough, but not everyone believes that this replication model is necessary on an intranet. For example, in Process Software's Purveyor, a Web server for Windows NT and NetWare LANs, the data storehouse is not a collection of data but a collection of URLs that point to objects wherever they exist. Because no documents or other files move, replication is unnecessary.

This sounds good, but it remains untested in the real world. Strictly speaking, Netscape does not replicate information; rather, it synchronizes information by preemptively distributing frequently used Web pages to server caches. This approach is not yet widely adopted, but it may become commonplace, because HTTP traffic is now growing much faster than total Internet traffic, and preemptive caching limits the impact on network bandwidth.

Netscape's Proxy Server 2.0 will cache frequently accessed Internet or intranet documents and use statistical analysis to determine which ones users are most likely to request. A batch-retrieval process downloads a group of URLs (up to 128 GB of data, or 70 million URLs) to ensure that the server caches the most popular sites and then makes them available. Netscape claims that when it deploys Proxy Server 2.0, there is a 50 percent to 70 percent chance that the servers will cache a document locally.

Netscape also offers replication on command through new scripting features. Proxy Server manages document expiration and version control, and it checks the home server every time it requests a document. Netscape's Catalog Server will provide an integrated index to search for any document type, no matter where it is.

Notes fans tout one other important aspect of replication: mobile workers. A traveling sales executive, for instance, can connect a laptop to a Notes server, replicate, and then work on databases, documents, and even discussion threads while on a plane. When the executive replicates again, that work is updated throughout the system. Intranets have not addressed this aspect of replication yet. However, some argue that the universal dial-up capability to the Web and the evolution of wireless modems will lessen the importance of this Notes feature.

Applications Development

Part of the groupware holy grail is a robust applications development environment so transparent that virtually any end user can build applications. On the other hand, groupware must also offer tools for programmers who create permanent enterprise-wide—and often mission-critical—applications. That's a tall order, no matter which solution you're contemplating.

In release 4, Notes has tools with three levels of complexity. *Agents* are made up of application logic that lets you automate tasks on servers and clients. You can set up simple agents, such as automatic "reply to sender" commands in a dialog box.

Lotus has also improved the often-cursed Notes macro language, which traditionally was the only Notes programming tool—if you bothered to learn it. New to release 4 is LotusScript, an object-oriented BASIC-compatible language. Developers say it's essentially Visual Basic with some additional commands. The big difference from Visual Basic is the LotusScript Data Object, a set of classes, methods, and properties that allows programs to access relational and legacy databases using Open Database Connectivity (ODBC). The process of learning LotusScript Data Object is about as easy as the process of learning any new Visual Basic extension. There is also a BASIC API for Notes, as well as APIs for the Notes server and client with either a C or a C++ interface.

For intranets, there's still no set of unified programming tools designed for programmers and programming illiterates alike. Instead, programmers have to accomplish amazing development feats by using Perl, Tcl, and CGI—tools not designed for this environment.

Sun Microsystems' Java programming language may revolutionize Web applications development. Java, an object-oriented language similar to C++, leaves out some vexing and rarely used C++ features, such as multiple inheritance and extensive automatic coercions. It adds automatic garbage collection to simplify programming and cut down on bugs. Its object-oriented facilities are essentially the same as those in C++, with extensions

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from Objective-C for more dynamic method resolution. The compiler generates an architecture-neutral object file format, which is executable on any processor with a Java run-time system.

Developers have not widely adopted Java yet, although Netscape and Microsoft browsers read Java. And everyone, including Lotus, plans to integrate Java with existing programming tools.

Netscape Navigator 2.0 and Netscape Navigator Gold 2.0 provide lightweight programmability through Netscape JavaScript, an API for cross-platform scripting of events, objects, and actions. It lets the page designer access events such as start-ups and user mouse-clicks. Based on the Java language, JavaScript extends the programmable capabilities of Netscape Navigator to a wide range of authors. It's easy enough for anyone who can compose in HTML to use JavaScript to glue together HTML, plug-ins, and Java applets.

Netscape LiveWire Pro, one component of SuiteSpot, is a visual development environment that has built-in database connectivity for building live on-line applications. Another of the planned midyear releases, it will ship with a run-time version of the Informix Online relational database and provide native client-library-interface (CLI) access to all major relational databases, including those from Oracle, Informix, Microsoft, and Sybase.

This gives database applications developers the flexibility to write portable applications using ANSI SQL yet obtain performance benefits from native database libraries. Among its many planned features, LiveWire Pro will compile applications that combine JavaScript, HTML, and images and then partition their execution across clients and servers.

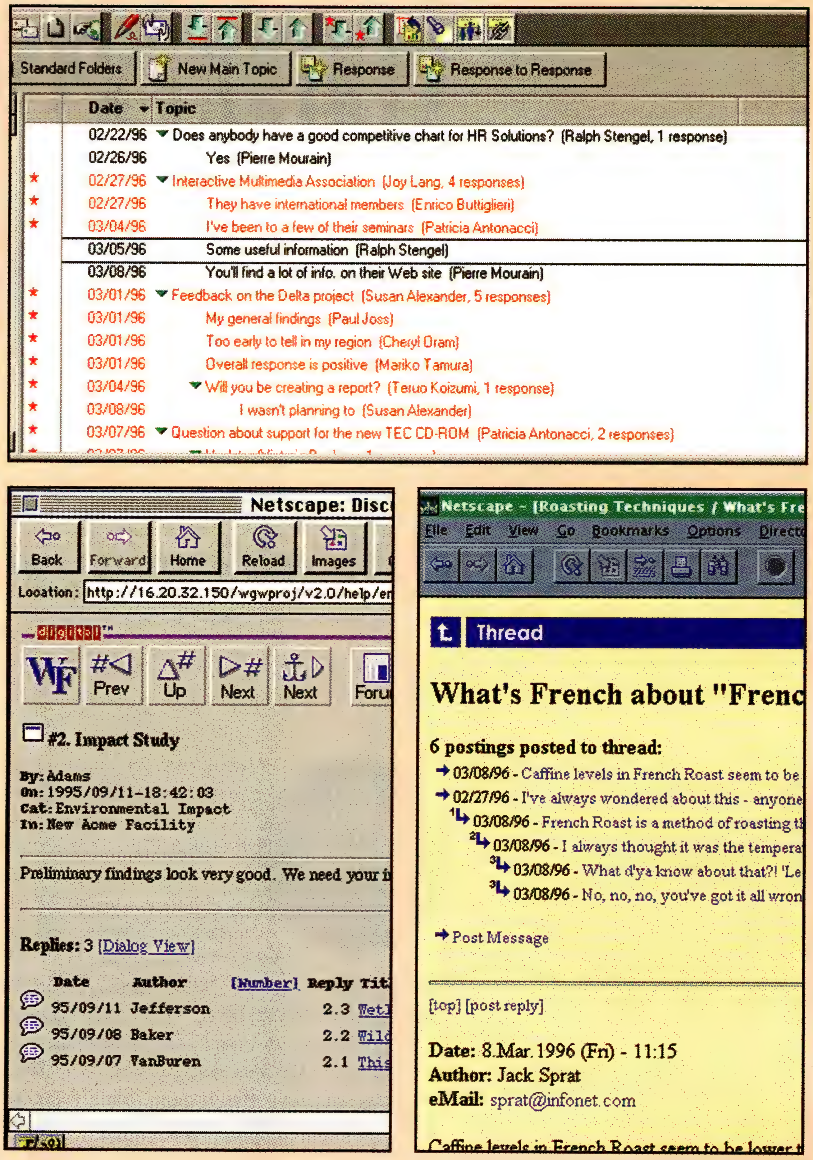
Other tools are "tags" in standard HTML. These coded pages trigger work flow and other collaborative applications. Cold Fusion Professional 1.5, a development kit from Allaire, lets you build collaborative applications that run on a Windows 95 or NT server and that any browser can launch on any platform.

A Cold Fusion application is an HTML page with Cold Fusion's Database Markup Language (DBML) tags inserted. These tags, written in C++, get processed by the Cold Fusion engine, which resides on the Web server and incorporates Access or SQL Server database technology. Cold Fusion then translates the tags into HTML.

DBML commands give Cold Fusion instructions on how to interact with databases, launch processes, and perform other tasks. Currently, to use Cold Fusion you have to code in HTML, but Allaire promises that later versions will have WYSIWYG coding and will incorporate Java. The company's vision is to produce dozens of applets, called *grouplets*, that allow you to build simple or complex groupware applications. Given Cold Fusion's Windows bias, it's likely to be most valuable in smaller departments and workgroups.

For more-industrial-strength applications, the answer may be WebObjects from Next Software, which also builds on the Web's request-response-page delivery model. A typical application contains an HTML template with standard markup elements and WebObject markup elements. When it runs, the application replaces WebObject elements with dynamically generated HTML code, which you

Threads on the Web



02/22/96 Does anybody have a good competitive chart for HR Solutions? (Ralph Stengel, 1 response)
02/26/96 Yes (Pierre Mourain)
03/27/96 Interactive Multimedia Association (Joy Lang, 4 responses)
02/27/96 They have international members (Enrico Buttiglieri)
03/04/96 I've been to a few of their seminars (Patricia Antonacci)
03/05/96 Some useful information (Ralph Stengel)
03/08/96 You'll find a lot of info. on their Web site (Pierre Mourain)
03/01/96 Feedback on the Delta project (Susan Alexander, 5 responses)
03/01/96 My general findings (Paul Joss)
03/01/96 Too early to tell in my region (Cheryl Oram)
03/01/96 Overall response is positive (Mariko Tamura)
03/04/96 Will you be creating a report? (Teruo Koizumi, 1 response)
03/08/96 I wasn't planning to (Susan Alexander)
03/07/96 Question about support for the new TEC CD-ROM (Patricia Antonacci, 2 responses)

http://16.20.32.150/wgwproj/v2.0/help/en

#2. Impact Study

By: Adams
On: 1995/09/11-18:42:03
Cat: Environmental Impact
In: New Acme Facility

Preliminary findings look very good. We need your i

Replies: 3 [Dialog View]

Date	Author	[Number]	Reply Tit
95/09/11	Jefferson	2.3	Wetl
95/09/08	Baker	2.2	Wild
95/09/07	VanBuren	2.1	This

What's French about "Frenc

6 postings posted to thread:

- 03/08/96 - Caffine levels in French Roast seem to be
- 02/27/96 - I've always wondered about this - anyone
  - 1 03/08/96 - French Roast is a method of roasting th
    - 2 03/08/96 - I always thought it was the tempera
      - 3 03/08/96 - What d'ya know about that?! 'Le
      - 3 03/08/96 - No, no, no, you've got it all wron

Post Message

[top] [post reply]

Date: 8.Mar. 1996 (Fri) - 11:15
Author: Jack Sprat
eMail: sprat@infonet.com

Caffine levels in French Roast seem to be lower t

Their branching structures look similar, but these groupware products manage workgroup conferencing in three different ways. You can access Allaire Forum (bottom right) from any browser on any platform; a polling feature in Digital Equipment's Workgroup Web Forums (bottom left) helps you reach closure in discussions; and Notes lets the sender of a thread embed a link to other documents, a database, threaded discussions, or Web pages.

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Notes and the Web: Peaceful Coexistence

Groupware integrators don't care as much about the technology they use as they do about the results they get. Some are tightly bound to Lotus Notes; others are exploring the Web; most, however, are weaving the two together.

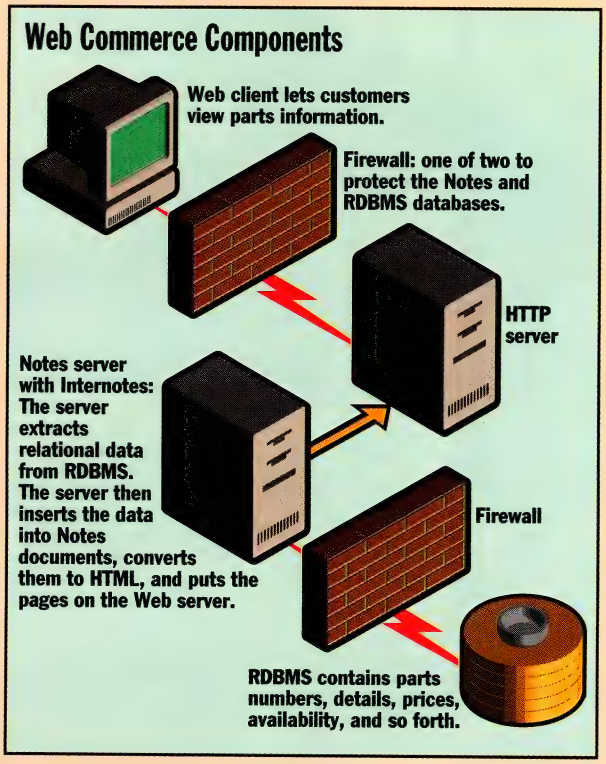
One such company is Uptime Computing Solutions (San Jose, CA), which has built dozens of groupware solutions using intranets and Notes. Michael Bertrand, Uptime founder and president, says the real problem is not the platform, tools, or programming languages. Work flow, business process, legacy data, and making Notes or the Web work smoothly and in a way that saves money are the critical issues, he adds.

Here is an example from Uptime's files that illustrates how Notes and an intranet can combine to make powerful groupware solutions.

Web Commerce

Notes is a robust applications development environment, but the Web shines in giving you a window to the outside world. That means there's a place for each in a business-to-business scenario.

Problem: A company makes thousands of components for the electronics industry and sells to thousands of customers. It wants to stop using paper catalogs and give customers timely and accurate information on the Internet. It also wants them to be able to place an order on-line. Information on specifications, price, and availability of parts now resides in a relational database that changes frequently.



Web Commerce Components

Web client lets customers view parts information.
Firewall: one of two to protect the Notes and RDBMS databases.
HTTP server
Notes server with Internotes: The server extracts relational data from RDBMS. The server then inserts the data into Notes documents, converts them to HTML, and puts the pages on the Web server.
Firewall
RDBMS contains parts numbers, details, prices, availability, and so forth.

Solution: A dynamic and secure Web page can allow customers to log on, search for the information they need, and order parts. The page's design can work so that the first time a user visits, the system records his or her IP number and issues a password for use during future visits. For tighter security, you could use Secure Sockets Layer (SSL) on your Web server and give each customer a Rivest-Shamir-Adleman (RSA) private-encryption key.

For extra security, you could use two firewalls: one located between the Internet and the Web server, which contains InterNotes, and the other between them and the Notes database and a relational database on the back end. In this way, it's not likely that anyone from the outside would breach the back end of your system and its mission-critical information.

Go Global

The company is global, so it has more than one relational database management system (RDBMS) and more than one Notes server. This means that replication is imperative.

Notes will replicate itself between servers. For the Notes-to-RDBMS connection, you can write an application in LotusScript Data Object that extracts from the RDBMS on request. Then, to protect the integrity of your RDBMS data, you can use a data pump–NotesPump or Replic-Action, from Casahls Technology–to periodically freshen the Notes database with whatever is new in the RDBMS.

You can write a work-flow agent to automate the order process. A customer can submit a form on the Web site, and InterNotes converts it to a Notes document, which a Notes agent then routes to the appropriate staff to fulfill the order. Sales executives and others can have access rights to monitor the speed and efficiency of order fulfillment.

Could you create this application with only open-standards Web products? Probably. The Casahls replication technology, for example, can go not only between Notes and an RDBMS but between an RDBMS and other object stores, including other RDBMSes. Some integrators are developing applications like this on the Informix/Illustra Universal Server, an "object-relational" database that combines relational properties and object properties in a single storehouse.

But object-oriented database technology is not as widely understood. If you're writing these applications today, you're still better off with Notes, which is designed specifically for such robust applications. However, the Web technology in this scenario is what makes publishing for the multitudes possible. You couldn't easily do that with Notes unless you outfitted every customer with a Notes client–a pricey prospect.

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specify in declaration files. Script files, written in your choice of programming language, include business logic specific to the application. WebObjects is platform- and database-independent.

The On-Line Store

Another technology essential to groupware is the information storehouse and the method it provides for giving and getting data. The Notes object store, which has evolved for years, has already tackled many vexing problems related to groupware. These include the ability to store all types of information, to link with other data stores in the enterprise, and to allow users to retrieve and organize information with support for full text searches, version control, and links to other documents and messages. By contrast, Web-based developers are buying or borrowing database technologies from other vendors. It remains to be seen if any of these technologies become as well-rounded.

At the heart of Notes is an object store containing documents, discussions, messages, and other free-form information that does not easily fit into relational database formats. The Notes object store is relational in one sense: By linking and embedding, it creates relations to other object text, spreadsheets, and graphics. The object store need not be in a single location; object stores can reside on any Notes servers that are linked and replicate regularly.

Within a Notes database, the end user

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chooses how to view documents. A form that contains several fields defines each document. A field can be as simple as a date, or as complicated as tabular material pulled from a spreadsheet or relational database. Using an interface that looks like an expandable outline, you can view the parents, the parents and the next generation, or all generations of a document. The search engine, from Verity, offers full-text searching and supports Boolean, wildcard, phrase, and sentence queries.

A Notes database, or one with similar properties, is essential to groupware. Users with permission can view, organize, and act on objects. The database is a place where messages can sit to allow for conferencing and threaded discussions. It's also a place where work-flow applications reside. Work flow often starts with or involves one or more documents.

Developers for intranet groupware are just starting to reckon with these issues. Traditionally, a Web repository consists of files on an HTTP server. With its purchase of Collabra, it's apparent that Netscape will integrate that object storehouse into its Web servers. Netscape Catalog Server (part of SuiteSpot) will provide some of the views functionality of Notes by creating an on-line catalog of intranet resources, such as documents and e-mail addresses. Like Notes, the Catalog Server uses Verity's search engine. Netscape also plans to support structured SQL queries.

Other storehouses for the Web include Digital's AltaVista Forum conferencing product, which uses a Notes-like database and Digital's AltaVista search technology. Allaire Forums, which is the first groupware product built with Allaire's Cold Fusion development tools, supports Access or SQL Server technology as its data store.

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The Notes object store is not a relational database; this is a shortcoming for transactional data processing. One way in which Notes users can address this problem is to use a pump that moves information from a relational database management system (RDBMS) to the Notes store. Commercial data pumps include NotesPump, from Lotus, and Replic-Action, from Casahls Technology. You can also use LotusScript Data Object to write applications that directly query the RDBMS.

Many Web-based groupware solutions are still using CGI applications for RDBMS queries. A hybrid "object relational database," from Illustra Information Technologies, offers another promising approach for relational database storage and the Web. Object-oriented database proponents argue that the Web's multiple data types—text, sound, images, and video—and its complicated relationships—among pages, content, and links—are more suited to an object-oriented approach.

Illustra and its new owner, Informix, will offer Universal Server, which will merge Informix's parallel-processing RDBMS core with Illustra's method for storing object classes within an RDBMS framework. One advantage: Universal Server will use Illustra's DataBlade technology, which lets you access and extract any type of data, including HTML or whatever else evolves from the Web. Groupware applications built on this platform have the potential to be powerful, but until Universal Server gains widespread use as a groupware engine, it's likely to remain the domain of integrators and others with object-oriented-database experience.

Smarter Messages

Messaging and notification are the final technology pieces of the groupware puzzle. Why are these elements important? Consider this scenario: You want your coworkers to look at a presentation you'll be delivering at your company's annual meeting. One choice is to send the entire presentation to everyone on your distribution list. A more efficient choice is to send a message asking everyone to view the presentation object, which resides in a commonly accessible database. You don't have to mass-blast a message with the large presentation file attached. Within Notes, an agent can tell relevant users when a document has new information in it.

This combination data-storehouse/notification system is at the heart of work-flow applications. With Notes, the two work together seamlessly; with applications development tools, you can create all manner of work-flow applications, ranging from forms routing and approval to document monitoring and management.

Intranets are not nearly so far along in this capability. Forms-routing-product vendors, including Action Technologies, JetForms, and Ultimus, achieve some aspects of work flow on the Web, but none of these products has robust applications development tools, a data storehouse, or a complete groupware solution.

Keep Your Notes

If you're keeping score, you will see that Notes has a head-start advantage over the Web as a groupware platform. But consider this: The smartest choice may be a strategy that combines the best of the Notes and Web worlds rather than picking one technology over the other (see the text box "Notes and the Web: Peaceful Coexistence" on page 76).

Some large corporations have already discovered this new world order by merging the Web (on the user side) with Notes (on the back end). "We see the Web and Lotus Notes—we have both—as complementary products," says Michael Stangel, a systems analyst at Eli Lilly & Co. and the person in charge of the pharmaceutical company's global intranet.

"What Notes does well is security and groupware. We don't yet have an infrastructure to support Lotus Notes across the enterprise. The Web focuses on distribution of information to a much wider audience, but not on groupware. Three years down the road, I see the Web and Notes merging into a single integrated technology," Stangel adds.

The lesson? If you tried to design a seamlessly integrated groupware platform from scratch, you might come up with something very much like the Web. Or you might come up with something resembling Notes. Then again, you might come up with a model that blends the best of both worlds. B

Bill Roberts is a writer and editor specializing in the Web. You can reach him at **Wcrober@aol.com.**

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Brave New Interface Worlds

The ties between people and computers tighten as software and hardware interfaces become more interactive.

Bartenders and therapists watch out: We may not need you to boost our egos anymore. After studying the psychological and physiological responses of people to computers, Stanford University's Clifford Nass and Byron Reeves report that computers can actually improve our self esteem. For example, participants in one study registered positive responses on brain scanners when a message of praise flashed across a screen. Even when the praise is random, we feel better when our computer treats us nicely, the researchers report (see "GUIs Get a Facelift").

Nowhere is this finding more important than in the development of interface design. In part, this means that tomorrow's GUIs will be friendlier in more concrete ways than just smiley faces and cute icons: They'll be cleaner and less cluttered, present error messages in a consistent tone and style, and, most important, be a tool to access any information we desire, whether it's on our local hard drive or halfway around the world on a Web server. To accomplish this, designers are mixing and matching the best characteristics of current GUIs and Web browsers to develop interfaces with a completely new look.

As GUIs take in a larger world view, virtual reality is settling into more mainstream applications. Virtual worlds will offer interface designers alternatives to standard 2-D icons to help us navigate GUIs easier and find information faster. New, nonproprietary authoring tools are helping to bring VR to general-purpose applications (see Dick Pountain's report in "VR Meets Reality").

Ties that bind us even more closely to computers will arrive later this decade. For example, eye-tracking technology lets computers peer into our eyes and monitor what screen images hold our attention (see "What Pupils Teach Computers"). Initial research shows that eye tracking helps people work faster than with traditional input devices and without the kinds of physical strain that can lead to carpal tunnel syndrome.

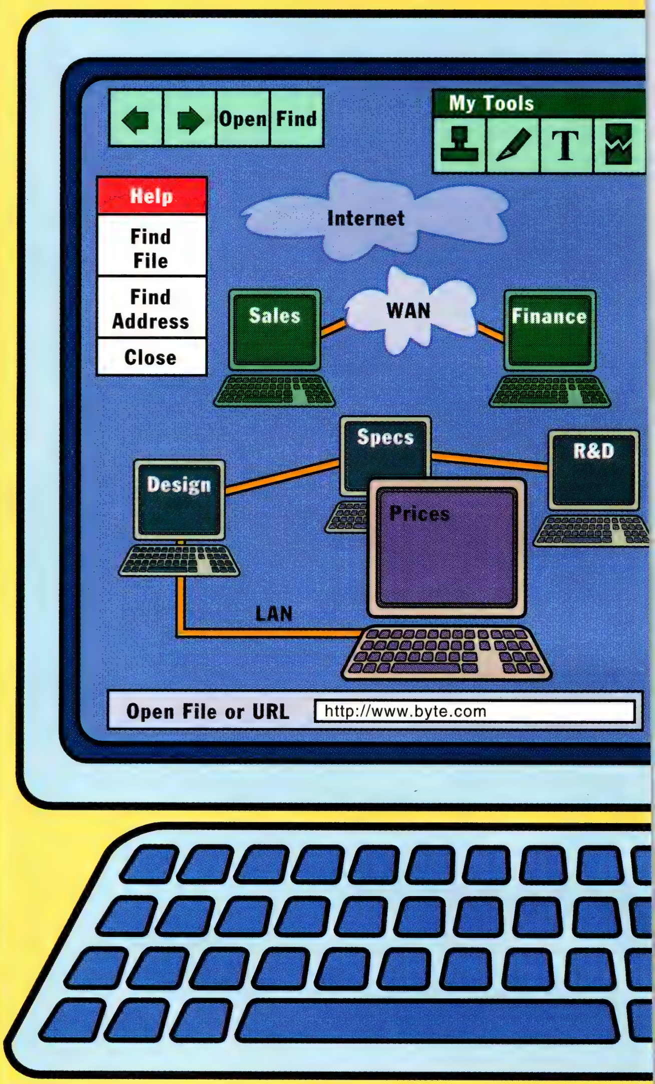
Thus we'll have better-mannered GUIs, VR systems that lead us to digital worlds, and I/O devices that gaze into our mind's eye. Every step we take away from our command-line roots takes us deeper into more efficient and more compelling relationships with our computers.

– Alan Joch

GUIs Get a Facelift...83

New graphical user interfaces will change the way developers write software.

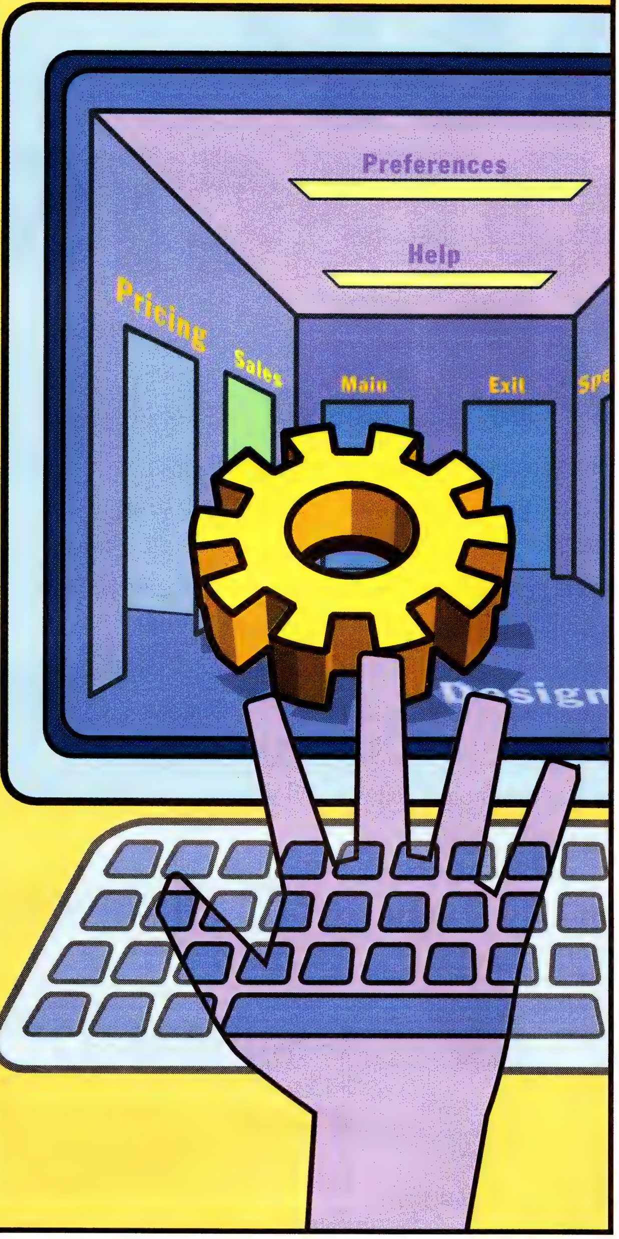
Tomorrow



VR Meets Reality...93

Virtual worlds will help people find and analyze information in mainstream applications.

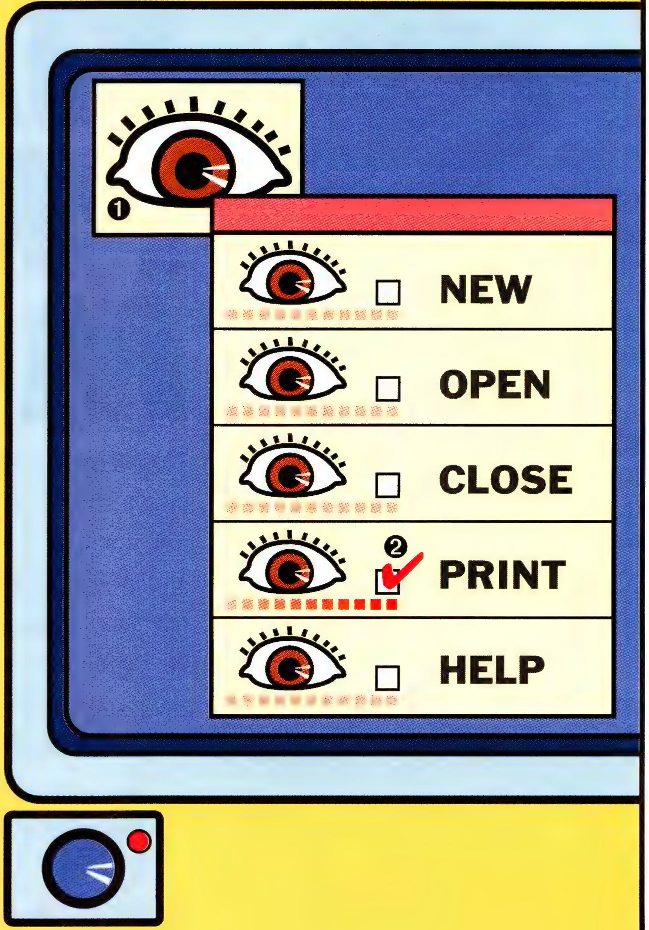
Next Year



What Pupils Teach Computers...99

Eye-tracking technology will initiate interactive dialogues between people and computers to help us work more efficiently.

Next Decade



❶ User gazes at "EyeCon" for the default 250-ms dwell time, and a pull-down menu appears.

❷ A dwell time of 100 ms highlights an item. If the eye lingers for 250 ms, the UI executes the command. If the user looks away from the menu for 600 ms, the menu retracts with no command.

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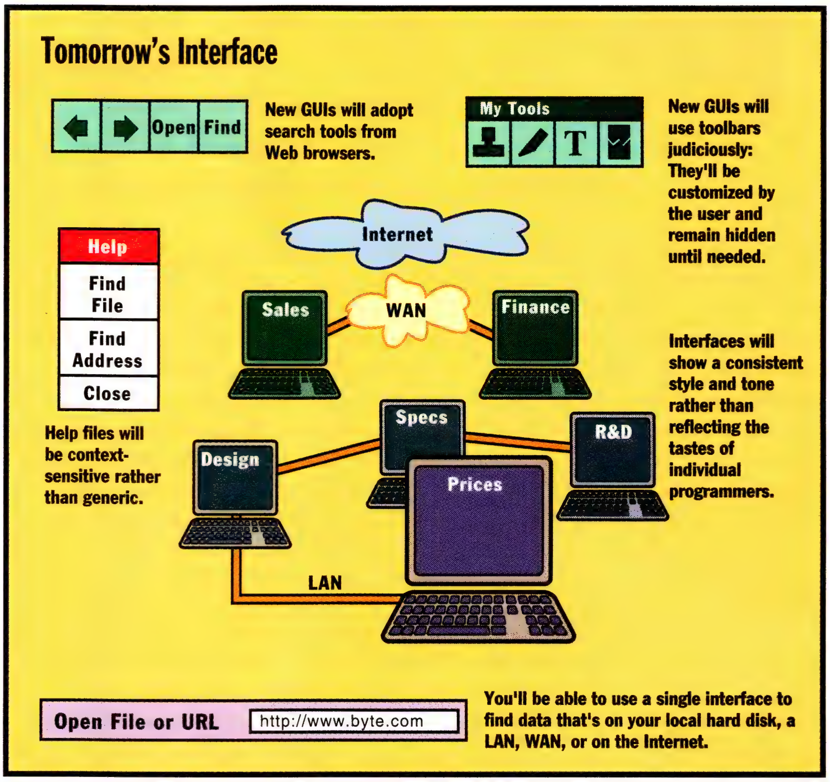
State of the Art

New graphical user interfaces will change the way developers write software. **By Tom R. Halfhill**

GUIs Get a Facelift

GUIs are sticky, or at least stuck. Except for relatively minor refinements, they haven't changed much since Apple introduced the Macintosh in 1984. But now they're about to break loose. It's no longer enough for a user interface to offer a graphical view of the local file system of a stand-alone computer. The coming trend in GUIs is to unify a rapidly expanding information space that includes LANs, WANs, the Internet, and the World Wide Web. Users will soon have new and more efficient ways to manage and navigate these vast repositories of digital information.



New GUIs will adopt search tools from Web browsers.

New GUIs will use toolbars judiciously: They'll be customized by the user and remain hidden until needed.

Help files will be context-sensitive rather than generic.

Interfaces will show a consistent style and tone rather than reflecting the tastes of individual programmers.

You'll be able to use a single interface to find data that's on your local hard disk, a LAN, WAN, or on the Internet.

Tomorrow's GUIs will be simple, customizable, and able to display local and remote data.

Some of these changes are coming fast, and they'll impact everything from operating systems to spreadsheets to Web browsers. Whether you're a commercial-software author, an in-house corporate developer, a hobbyist programmer, or a casual user, your work will almost certainly be affected as GUIs struggle through their next stage of evolution.

This summer, for instance, Microsoft plans to introduce an upgrade for Windows 95 and Windows NT that will extend the graphical metaphor of Web browsers to encompass the entire file space, both local and remote. By using familiar-looking Web browser tools and controls, you'll be able to find and display information that resides on your local disk drives, your company's LAN, a private intranet, or the global Internet.

Another influential company that's rethinking the GUI is Apple. Upcoming versions of the Mac OS (code-named Copland and Gershwin) will introduce sophisticated search-and-retrieval tools and a scalable desktop that's easily customized for a wider range of users.

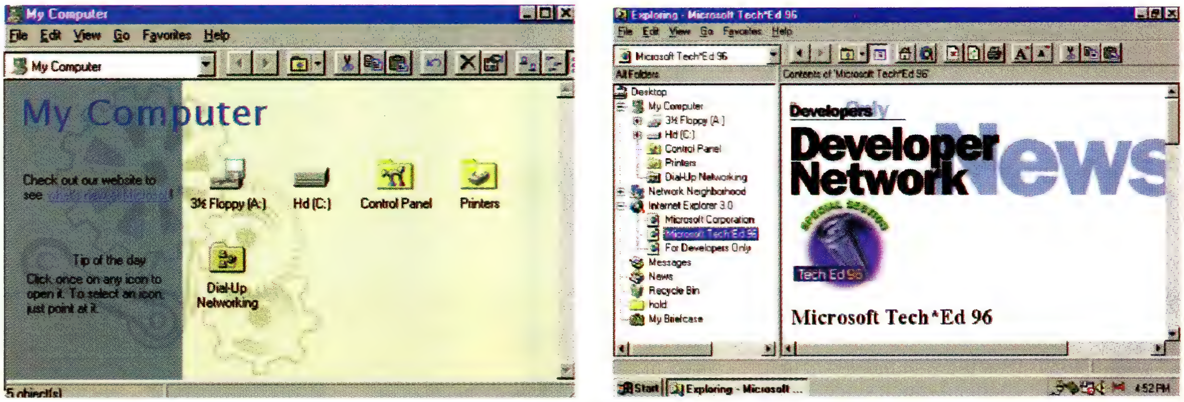
Looking further ahead, even more radical changes are coming from the famous user-interface experts at the Xerox Palo Alto Research Center (PARC) and from the designers of low-cost network computers. At PARC, researchers are experimenting with fascinating 3-D views and graphical representations of file systems and databases. Meanwhile, the companies leading the charge on network computers—notably Oracle and Acorn—are working on simplified GUIs for business users, students, and consumers who don't necessarily need a conventional graphical desktop.

The Web Metaphor

It's not that today's GUIs are obsolete. Indeed, GUIs have transformed the face of computing over the past 12 years, starting with the Mac and culminating with Windows PCs. But some aspects of GUIs are not keeping pace with changing markets and demands.

First, there's the need to make computers accessible to a broader range of users. As computers become more pervasive in business and society at large, the pool of enthusiastic, knowledgeable users becomes a smaller part of the whole. Just because some people aren't thrilled to embrace the wonderful world of computing doesn't mean they don't deserve well-designed software that helps them accomplish their tasks.

Another factor driving GUI evolution is the information explosion. Computers are storehouses for a huge amount of information, but it's of little use if you can't find it. This information is widely distributed across local storage devices (which may exceed a gigabyte), private networks (which may hold terabytes), and the Internet (whose resources surely add up to petabytes). The GUIs, file systems, and applications of the '80s weren't designed for cataloging or navigating



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Microsoft Tech*Ed 96

Microsoft's new Web View for Windows 95 (left) and NT extends the metaphor of Web browsing (note the toolbars) to the entire file system and network.

such large and widely dispersed archives.

Netscape Navigator, the most popular Web browser, is largely responsible for redefining how users explore the on-line part of this information. Navigator also supports a growing collection of plug-in components that are revolutionizing the way users interact with the data they retrieve. Why not extend that metaphor to all the search-and-retrieval functions that users perform on their systems?

"The information space shouldn't have arbitrary boundaries between local information and information that's found elsewhere in the world," says Bruce Horn, a computer-science consultant who formerly worked at Xerox and Apple, where he played a major role in designing the original Mac GUI in the early '80s.

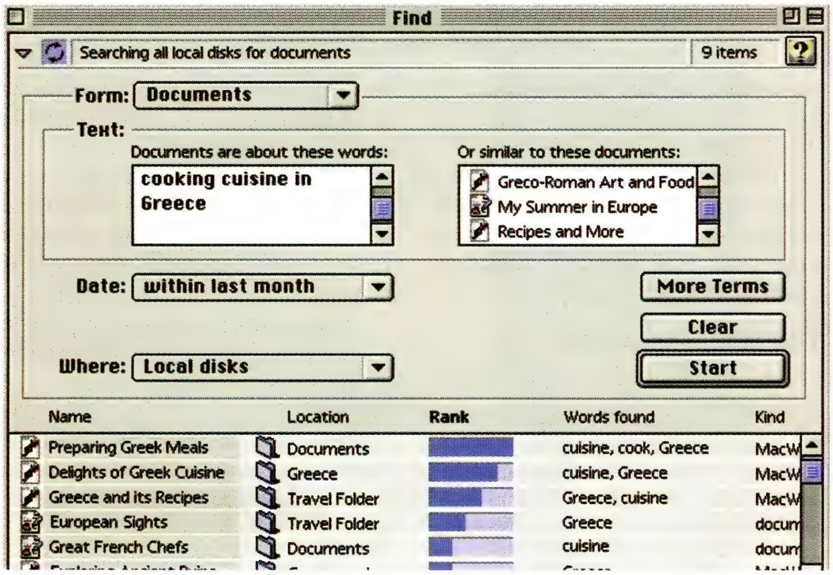
Microsoft is jumping on this idea. The company plans to soon ship an add-on package for Windows 95 and Windows NT that contains a number of Internet-related components. (This package was once referred to as the "Nashville" upgrade for Windows 95, and may be called the Internet Plus Pack when it's released.) Among other things, there will be a new option in Windows, tentatively known as Web View or Page View, that brings the look and feel of a Web site to your local file system and network.

For example, instead of maneuvering through nested files and folders with the traditional tree view in Windows Explorer, you can browse your disks with a user interface that resembles Netscape Navigator's. You click on buttons labeled Forward or Back to surf through Web-like pages that Windows creates on the fly in Hypertext Markup Language (HTML). You can jump directly to any file or folder by typing a path name, as if it were a uniform resource locator (URL) on the Web. If you enter an actual URL address, you'll link to a real Web page on a remote server.

Web View is similar to the graphical front ends we now see on private intranets, except it doesn't require an HTTP server or separate Web client software. The browser interface is part of Windows and floats above the existing network stack.

Developers can adapt this Web-like GUI to their own programs, and even modify how the OS displays Web Views on the screen. The foundation beneath Web View is an open API that's accessible from any tool that can use ActiveX controls (formerly known as OLE Controls, or OCXes), including Microsoft's Visual Basic, Visual C++, or Borland's Delphi. In the future, says Microsoft product manager Michael Ahern, advanced users will be able to access these features with Visual Basic for Applications (VBA), the scripting language built into some Microsoft Office programs.

The Windows upgrade package installs the new APIs in the form of DLLs and ActiveX controls. For instance, one ActiveX control displays HTML pages; another returns a data stream from a URL-addressed server. There's also a new ActiveX software-development kit for developers. Armed with these components, you can write Internet-aware custom applications that integrate seamlessly into the Web View environment, without



Searching all local disks for documents 9 items

Form: Documents

Text:

Documents are about these words:
cooking cuisine in Greece

Or similar to these documents:
Greco-Roman Art and Food
My Summer in Europe
Recipes and More

Date: within last month

Where: Local disks

Name	Location	Rank	Words found	Kind
Preparing Greek Meals	Documents		cuisine, cook, Greece	MacW
Delights of Greek Cuisine	Greece		cuisine, Greece	MacW
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European Sights	Travel Folder		Greece	docum
Great French Chefs	Documents		cuisine	docum

Apple's new search tool in Copland displays a hit list ranked by relevance (at bottom), much like the search engines on the Web.

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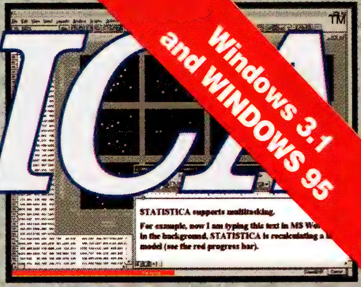

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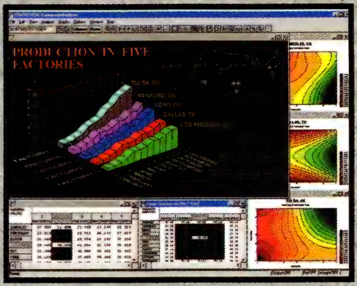

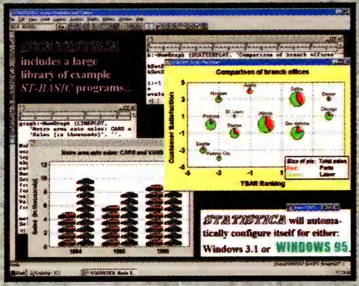

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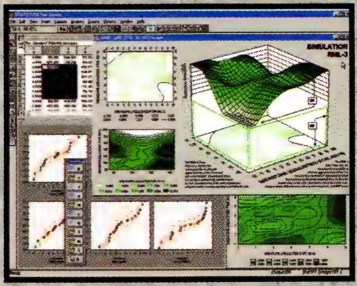

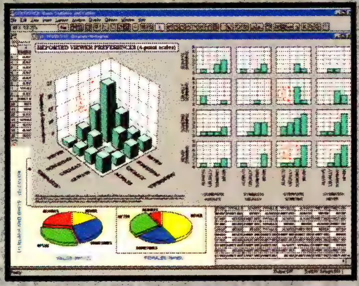

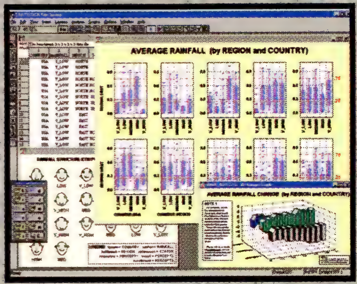

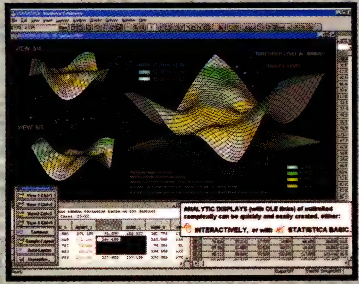

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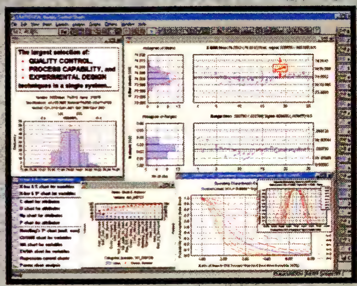

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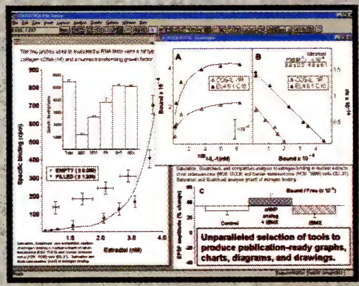

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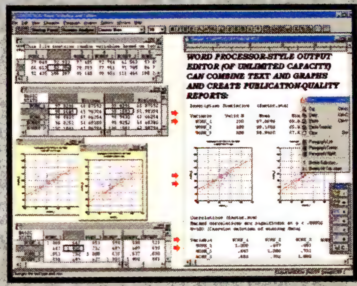

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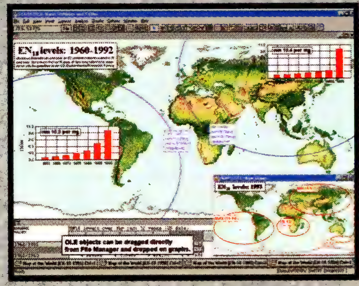

OLE objects can be dragged directly from File Manager and dropped on graphs.

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Circle 89 on Inquiry Card.

understanding the intricacies of HTTP and HTML.

You can also hack the Web View pages that Windows displays. Windows keeps HTML templates for these pages, then calls ActiveX controls to fill in the dynamic data on the fly. By modifying the templates, you can customize the Web Views. A corporation could flash its corporate logo on every page, or automatically display a readme file of pertinent information whenever a user accesses a particular file, folder, or server.

Microsoft is extending the Web metaphor to documents, too. Applications that support the Windows DocObjects API (such as Microsoft Word, Micrografx Designer, and Visio) can display binder documents in Web-like containers. In other words, the document appears on the screen as a highly formatted Web page. This opens the door for third-party developers to write custom applications that also take advantage of the Web metaphor.

Not everyone is convinced this metaphor should be pushed that far, however. "Weaving together content-viewing and information navigation is a neat idea, but not everything makes sense if presented as a Web page," says the consultant Horn. "You could navigate your address book as a Web site, but do you want to? Does a CAD drawing make sense if presented as a Web page?"

Fortunately, Web View is only an option—you can ignore it and use Windows the same way you always have. If the Web metaphor turns out to be merely an interesting experiment instead of a significant step forward in GUI evolution, it'll go down in history as just another of the periodic makeovers that Windows users have come to expect. (No GUI has changed as much as Windows has in the past decade.) But even if it's not the Holy Grail of GUIs—a one-size-fits-all solution—the idea of browsing the entire information space with a common front end has a lot of appeal.

Scaling the Wall

Microsoft and Apple are by far the leading vendors of system software, so they exert irresistible influence over the look and feel of applications that run on their OSes. Now they are traveling along paths that are both convergent and divergent. For example, both companies are developing advanced file systems that apply

How Computers Press *Your* Buttons

If your computer sometimes makes your blood boil, you're perfectly normal. In fact, a Stanford University researcher claims that computers stimulate a wide range of emotional responses that mirror real-life human interactions.

"People respond to computers according to the same rules and principles that govern how they respond to other people," says Clifford Nass, an associate professor of communications at Stanford. Nass and colleague Byron Reeves have conducted more than 40 scientific experiments that measure the physiological and psychological responses of computer users. They are publishing their findings in a new book, *The Media Equation: How People Treat Computers* (Cambridge University Press), that contains some fascinating insights for software designers.

For example, Nass and Reeves tested how users respond to educational software that speaks with male or female voices. They discovered that people consider "male" computers to be better teachers of technical subjects, but prefer "female" computers for more personal subjects. Should software developers adhere to these stereotypes or rebel against them? Nass dodges that question: "We're scientists, not politicians."

However, he does offer more concrete advice on other subjects. Above all, Nass emphasizes that computers don't have to be artificially intelligent or even particularly sophisticated for people to react to them as if they were real people. In one experiment, Nass and Reeves used a simple text-based terminal to see how people responded to commands worded in dominant or passive language. Result: Users with dominant personalities disliked passive computers, and users with passive personalities disliked dominant computers.

"The minute you put words on the screen, you've got a social interface," Nass says. "If it's got contingent behavior, if it fills a social role, and if it uses language, people will perceive it as a person."

Six Tips for Better Interfaces

After studying the physiological and psychological responses of computer users, Stanford University's Clifford Nass says savvy user-interface designers should keep these key issues in mind:

1. Error messages should have a consistent tone and style. Many programs are inconsistent because different programmers wrote the error messages, often as an afterthought. Whether the tone is dominant, passive, friendly, or businesslike can vary according to the type of application, but it must be consistent. "Although different people like different personalities, nobody likes a confused personality," Nass says.

2. Users should be able to customize their software, but it's better to offer them a few preconfigured choices instead of forcing them to set a zillion separate options. "If I asked you to describe your ideal best friend, you'd probably have trouble," explains Nass. "But if I showed you 10 people and asked you to choose the one you like best, you'd find it much easier."

3. Avoid the overuse of modal alerts (messages that float atop all other windows and must be dealt with immediately). "A modal alert is like yelling 'Fire!'"

4. Context-sensitive help is much better than large, generic help files that give too much nonspecific information. If someone asked you for a phone number, would you recite the phone book?

5. Toolbars are frustrating because users must remember what all the obscure little icons mean. "They violate the principles of understandability and comprehension," says Nass. Toolbars are acceptable if the user creates the shortcut button. The toolbar should remain hidden by default until the user is ready for it.

6. Practice random kindness and senseless acts of beauty. In one of their most interesting experiments, Nass and colleague Byron Reeves discovered that users exhibit a measurable physiological response to random praise, even if the praise is undeserved, and even though people deny that praise from a computer matters to them. Does this mean software developers should counterbalance their error messages with occasional "praise messages"? It sounds crazy, but Nass and Reeves actually designed a spelling checker that not only flags spelling errors but also randomly praises the user for spelling difficult words correctly. The program generates positive responses that can be measured on brain scanners.

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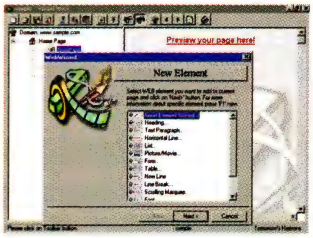

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object-oriented principles and database technology to the problem of managing vast stores of information. But Apple is taking a different approach to browsing that information within a GUI.

Instead of adopting the Web metaphor, Apple is working toward a more conventional user interface that's scalable, somewhat like a computer game with multiple difficulty levels. Apple's goal is to present a graphical desktop that grows with users and allows them to transfer their newly learned skills to higher levels. But unlike a game, it won't have distinct stages. Users (or system administrators) will be able to customize nearly every aspect of the interface for a wide range of skill levels.

"People talk about computer users as if they belong to discrete categories, such as beginners or experts," says Paulien Strijland, manager of Apple Computer's Human Interface Design Center. "But some users are beginners in some areas and experts in others."

Some of this thinking will show up in Copland, the next major release of the Mac OS, which will probably ship in early 1997. More elements will appear in Gershwin, a later release. Copland will incorporate most of the features of Apple's At Ease, a stand-alone product for today's Macs that strips down the Finder to single-click buttons for launching applications, a limited selection of menu items, and restricted access to software folders. Copland will allow multiple users sharing the same machine to have their own customized environments, or workspaces, which can be optionally protected by passwords. (Apple says two-thirds of all Macs are shared by more than one user.)

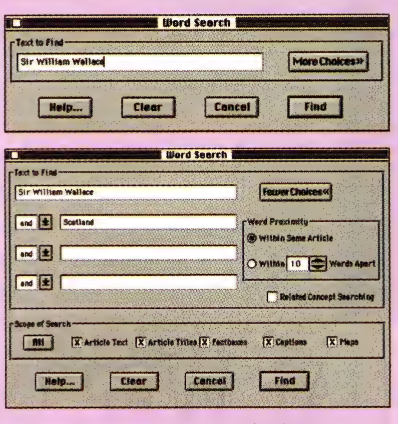
These workspaces will include user-selectable themes, or personalities that radically alter the appearance (though not the basic functions) of the GUI. You can customize the Finder to display windows, menus, and dialogs with bright colors and squiggly lines, or configure it to mimic the dark, brooding tableaux of cyberpunk science-fiction films.

These changes shouldn't cause problems for software developers. Apple is implementing the new features in the Mac OS Toolbox, so existing applications will automatically inherit the behaviors. One notable exception: The simplified options in the Finder don't echo throughout applications. Developers who want to offer similar features will have to add new customization options to their programs.

Apple is also building Web-like search-and-retrieval tools into Copland, though within the framework of a conventional GUI. On the Web, you don't usually search for information by looking for specific filenames; you look for topical keywords by using search engines, such as Yahoo or Alta Vista. Copland will dynamically and transparently maintain an index of all textual information contained in the Mac file system, just as Web crawlers, like Alta Vista, do for the Web. You can quickly retrieve files by searching for keywords. After each search, Copland displays a list of hits sorted heuristically by relevance, much like the hit lists

The Good, the Bad, and the Politically Incorrect

GOOD



Sir William Wallace

Sir William Wallace

and Scotland

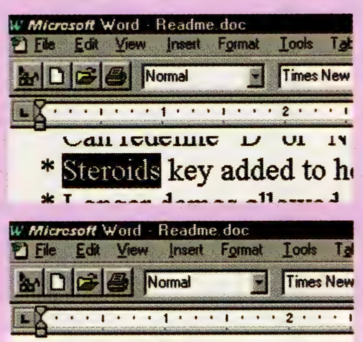
● Within Same Article

○ Within 10 Words Apart

☐ Related Concept Searching

☒ Article Text ☒ Article Titles ☒ Factbases ☒ Captions ☒ Maps

To avoid screen clutter and confusion, let users decide if they want to see the full range of options. This search dialog in Grolier's Multimedia Encyclopedia has a button that expands or contracts the dialog to offer simple or advanced features.



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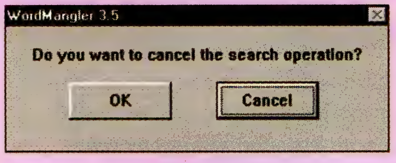
* *Steroids* key added to h

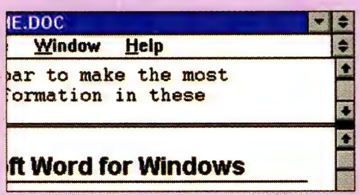
When you italicize text in Microsoft Word, both the selected region and the cursor automatically slant to match the italics text style. It's a small touch, but it helps users determine if the selection includes spaces immediately before or after the italicized text.

BAD



Do you want to cancel the search operation?

Beware of confusing messages. In this dialog, clicking the OK button actually cancels the search operation, but the user might easily click the Cancel button instead—especially since it's highlighted as the default button.

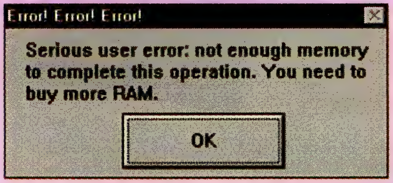


ar to make the most
ormation in these

ft Word for Windows

Avoid crowding a bunch of similar buttons or controls into a small area of the screen. This confusing hodgepodge in Windows 3.1 was cleaned up in Windows 95.

POLITICALLY INCORRECT



Serious user error: not enough memory to complete this operation. You need to buy more RAM.

Apple's guidelines for interfaces discourage use of the word *error* in error messages because it implies the user is at fault.

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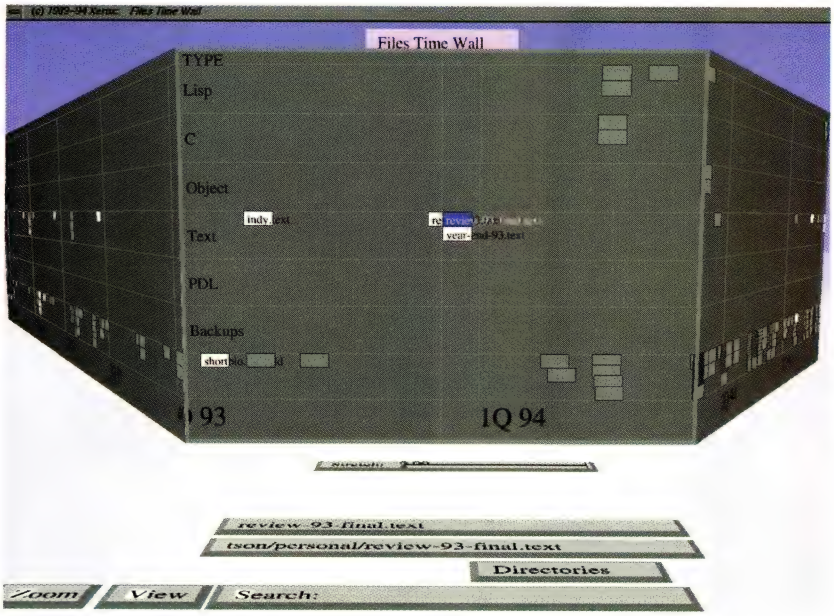

XSoft's Visual Recall, based on technology developed at Xerox PARC, displays a 3-D perspective view of a large database.

returned by Web searchers. You can save your search parameters as a clickable icon, and Copland will dynamically update the results to match the changing contents of your file system.

For now, however, Apple is not offering a common user interface for all search functions—whether local or remote—as Microsoft is doing with its Web View. Copland's designers say they don't rule out this option, but they hesitate to move away from a stable and successful GUI that millions of people are comfortable with. "We don't take lightly the introduction of new user-interface gadgets or widgets, even if they're something we personally think is cool," says Mitch Stein, Apple's director of human interface technologies.

Thus, for the first time, Microsoft is adopting a GUI that wasn't pioneered by Apple. It will be an ironic turnabout if Microsoft's Web View proves so popular that Apple feels compelled to follow suit.

Recommended Reading for Software Developers

The Windows Interface Guidelines for Software Design
Microsoft Developer Network Development Library (CD-ROM)
http://www.microsoft.com

Programming the Windows 95 User Interface
Nancy Cluts, Microsoft Developer Network Technology Group
Microsoft Press, 1996

Making It Macintosh: The Macintosh Human Interface Guidelines Companion (CD-ROM)
Apple Computer
http://www.apple.com

On the Horizon

Two more developments that could radically change our concept of GUIs are network computers and 3-D graphics. Interestingly, software designers seem to be taking these technologies in opposite directions. Some prototype network computers have greatly simplified GUIs, even discarding such familiar elements as overlapping windows and pull-down menus. But the GUIs built with 3-D graphics and other advanced techniques are cramming more information than ever onto the screen.

Network computers will probably be extremely diverse, so it's risky to make generalizations based on early prototypes. However, the reference design that Oracle previewed in February sported a GUI that was obviously intended for computer-illiterate consumers. No windows, no menus, no complicated file system. Instead, there were just a few one-click icons that launched a Web browser, an e-mail program, and a selection of games.

Of course, network computers aren't just for neophyte consumers. In schools and businesses, where they're supposed to dramatically reduce administrative costs, the GUI will be tailored for specific applications. An order-entry program or a database-retrieval system might abandon the complexity of a full-powered GUI in favor of a single-purpose front end that's less vulnerable to tampering and is therefore easier to maintain. The goal of this kind of GUI is to limit, not expand, the user's choices. It's an indication that future GUIs might be more targeted for particular types of users—a departure from the one-size-fits-all quest. (See "Inside the Web PC," March BYTE.)

Perhaps that's why the early examples of GUIs that take advantage of 3-D and higher-resolution graphics appear to be aimed at power users. With an extra dimension and more pixels to play with, designers can't seem to resist creating more complex views that allow users to navigate file systems and databases in new ways. At Xerox PARC, for example, researchers are experimenting with perspective views and hyperbolic graphics that can extend infinitely into virtual space, just like the file systems and databases they represent.

It's becoming clear that the relatively slow progress of GUIs over the past decade was only a transition period; PCs needed time to complete their move from DOS to graphical desktops. But that was just the first step. GUIs will continue to evolve because today's desktop metaphor isn't ideal for all kinds of users, and new demands are straining the ability of conventional GUIs to keep up. Tomorrow's graphical interfaces will reflect the growing diversity of users and the new tasks they need to accomplish. B

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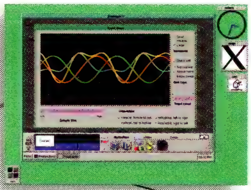

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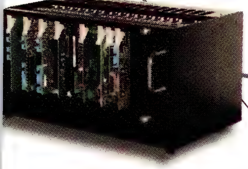

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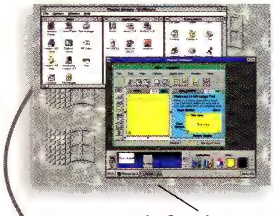

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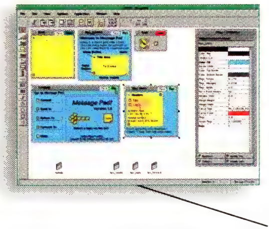

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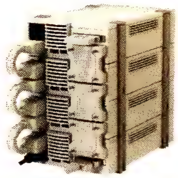

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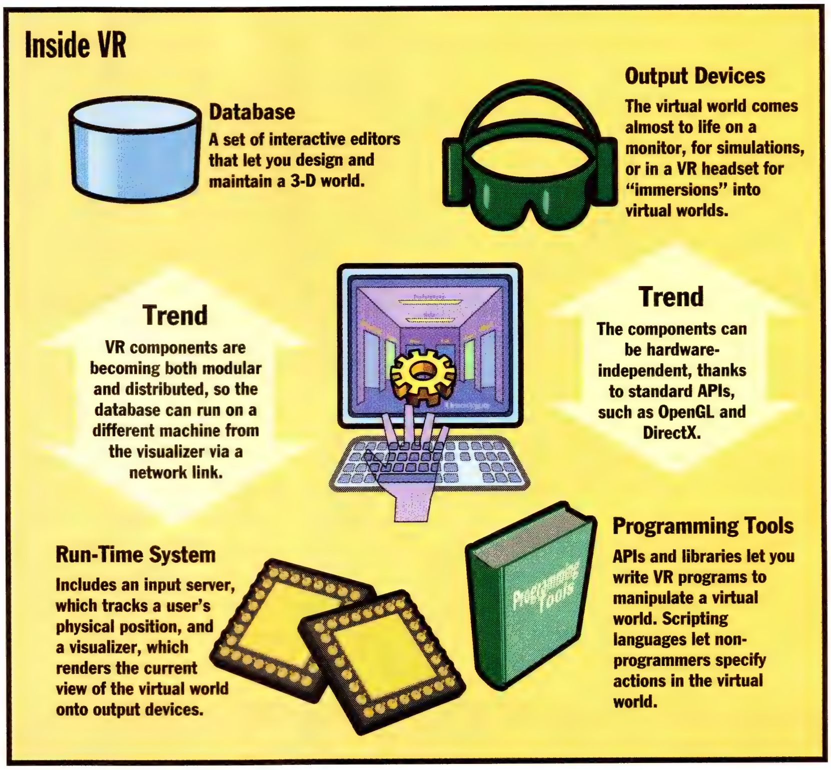
Circle 62 on Inquiry Card.

Virtual reality strengthens the link between people and computers in mainstream applications. **By Dick Pountain**

VR Meets Reality


Inside VR
Database
A set of interactive editors that let you design and maintain a 3-D world.
Output Devices
The virtual world comes almost to life on a monitor, for simulations, or in a VR headset for "immersions" into virtual worlds.
Trend
VR components are becoming both modular and distributed, so the database can run on a different machine from the visualizer via a network link.
Trend
The components can be hardware-independent, thanks to standard APIs, such as OpenGL and DirectX.
Run-Time System
Includes an input server, which tracks a user's physical position, and a visualizer, which renders the current view of the virtual world onto output devices.
Programming Tools
APIs and libraries let you write VR programs to manipulate a virtual world. Scripting languages let non-programmers specify actions in the virtual world.
Programming Tools

As the basic building blocks of VR systems mature, applications are no longer bound to proprietary hardware platforms.

Mention virtual reality (VR) to most people, and they conjure up visions of mutant space invaders or Indy cars racing around a track. But you can use VR just as well to experience a new building design, safely examine the hazardous world of a nuclear reactor core, or see how a hidden steering assembly stands up to a country road. The more VR matures—and runs on common platforms, such as Windows-based x86 machines—the more we see VR for what it really is: another way for people to interact with computers, rather than some psychedelic other world where fantasies come true.

The prosaic reality is that you can get out of a virtual world only what you put into it; until recently, building virtual worlds was such a chore that what you got out was, frankly, not very much. That's all set to change with a new generation of VR authoring and delivery tools that take enough of the pain out of building VR systems to make them a practical proposition for businesses.

Corporate developers can build VR applications that range from simple to complex for single users or client/server environments. The trade-offs among these systems are like those for any traditional development platform: The tools that are easiest to use produce the most basic applications. But the choice of products lets you put together the right package of tools for your needs.

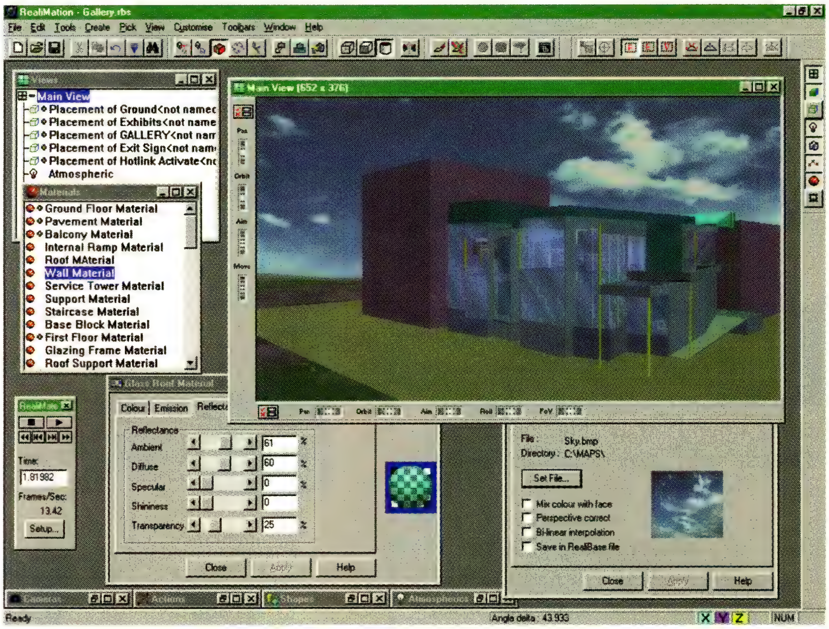
Virtual Windows

Typical of the new generation of VR authoring tools is Datapath's RealiMation, a software suite for developing VR systems on platforms ranging from low-end PCs up to networks of workstations. As its name suggests, RealiMation combines the attributes of reality and animation for VR, simulation, and game applications. RealiMation has the concepts of time and motion built into it so that, in addition to defining and traversing an interactive virtual world, you can define motions and trajectories for the objects in that world and capture the results as animation for later replay.

RealiMation consists of three main components. The RealiBase database contains descriptions of the appearance and behavior of objects in your virtual world; RealiLib is the API via which you can write C programs to manipulate the virtual world and create custom applications; and RealiMationSTE (Space Time Editor) is the tool that brings database entries almost to life. This space and time editor lets you interactively create and modify RealiBases and also acts as the run-time support to deliver finished systems: You can create a complete walkthrough or simulation using just the STE with no programming involved. The STE is not a 3-D modeling tool, but you can import objects created with other tools, including 3-D Studio and AutoCAD DXF, as well as Virtual Reality Modeling Language (VRML) files.

Tools like RealiMationSTE show how far VR has grown since its early days in research labs. Instead of proprietary and arcane systems, developers now have development kits that run on general-purpose OSes and processors. For example, RealiMationSTE is a 32-bit program that runs under Windows 95 or NT, and it supports hot links that let you attach data and behavior to 3-D objects.

Why is this imporant? Say you want a client to walk out onto the terrace of a building you've designed, and in addition to the look of the space you want to simulate the rush of urban life whirring around the building. Hot links trigger



Time: 1.81982
Frames/Sec: 13.42

Ambient 61 %
Diffuse 60 %
Specular 0 %
Shininess 0
Transparency 25 %

File: Sky.bmp
Directory: C:\MAPS\

☐ Mix colour with face
☐ Perspective correct
☐ Bi-linear interpolation
☐ Save in RealiBase file

Ready
Angle delta: 43.933

RealiMation supports multiple cameras, which you can instruct to travel through a virtual scene on preset trajectories.

WAV sound files and a video clip as the client "walks" through the door to this virtual terrace. Hot links can activate any executable program, another RealiBase (allowing a "tunnel" between worlds), or even a uniform resource locator (URL) so you can create 3-D Web browsers.

Another nod to the real world is the fact that RealiMation is a portable and distributed system. RealiBases are processor-independent, so you can view the same world on anything from an x86-based PC to an SGI Indigo. You can develop an application on a single PC and then run it as a client/server system with the application running on one machine and one or more remote RealiMation servers performing the image generation.

You just relink your application to the RealiNet library: There is no need to recompile it. Further, each RealiMation server can support multiple channels into the same RealiBase, and each channel can show a different viewpoint. This lets you hang multiple monitors or headsets off the machine, which greatly simplifies the development of multiuser training simulations and games.

RealiMation supports third-party rendering hardware, so it's independent of any display technology. This should ensure early support of the new 3-D accelerator chips, such as GLINT and nVIDIA, that will soon flood the market. At present, the program supports OpenGL, Criterion RenderWare, and Intel 3DR, with Microsoft's DirectX, Apple QuickDraw, and Argonaut BRender support in the works. You can even hot-swap render engines at run time, and the display instantly changes to reflect the new algorithm.

VR: What Is It Good For?

Building a virtual world inside a computer is a useful thing to do in a surprisingly wide variety of commercial, industrial, scientific, medical, and military applications. A virtual world is easier to control than the real one. If you're an architect who needs to show how the shadows will fall around your new building, virtual reality (VR) can make the sun come up and go down at your will without any magic rituals or messy human sacrifices.

The list of applications goes on: Architects find it can be less expensive to build a VR model than to build a real-world prototype. Automotive and aerospace manufacturers, such as Ford and Lockheed/Martin, routinely build virtual models as part of the CAD/CAM process to check ergonomics and help sell a new model before it's even built.

A virtual world can make the invisible visible and the abstract concrete. Many of the scientific, engineering, and financial applications of VR can help us visualize complex data sets derived from say, chemistry, fluid dynamics, or meteorology by turning them into apparently real objects that you can manipulate.

A virtual world can add value to the real world by using telepresence or augmented-reality systems. A camera-equipped robot can travel through a hazardous real place (e.g., a nuclear reactor) while the human's presence is purely virtual. Medical researchers are testing VR systems that can superimpose views of the body's internal organs generated from computer-aided tomography (CAT) scans over the real body to give a surgeon wearing a 3-D headset something like Superman's X-ray vision.

VR is a good gimmick; there's no sense in being precious about this. There are lots of applications, such as point-of-sale display, trade-show booths, and other advertising- or publicity-related activities, where VR is an end in itself–the novelty of the medium sells the message. You probably won't buy a house solely on the strength of a VR walk-through, but the novelty of it might tempt you to go view the real thing.

If you develop entirely within a Windows environment, there is an OLE developer edition that turns RealiMation into an OLE automation server. Thus, you can build 3-D visualization systems that use existing data-analysis tools, such as Excel and Mathematica.

Virtech, based in Fife, Scotland, used RealiMation to help quell fears that a proposed parking lot for a Loch Ness visitor center would ruin the landscape. Historic Scotland commissioned a RealiMation-based virtual walk-through to show local residents how the lot's appearance would blend in with the surrounding area. To add to the challenge, the historical agency needed the simulation in just 14 days.

Virtech used the RealiMation API to build a front end that reads in survey files and turns them into virtual worlds. Historic Scotland had been quoted prices of up to $330,000 by other firms, but Virtech did it for a fraction of this figure. "Building models manually used to be slow and expensive, but nowadays we can always find some way to automate the process using the [RealiMation] API," says John Kelly, technical director of Virtech. "And we can deliver [the simulation] on a PC rather than on an SGI [machine]."

Client/Server Worlds

While Windows and less-expensive x86 hardware can now support VR, some VR pioneers, including Ford, Gulfstream,

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Circle 93 on Inquiry Card.

McDonnell Douglas, and the U.S. Army Research Lab, need scaled-up platforms that work in a highly distributed client/server environment. For these applications, Division offers dVS, a Unix-based OS layer that supports VR systems on parallel and distributed hardware. Division makes its own parallel graphics accelerator hardware, but the firm has also ported dVS as a software-only product onto Silicon Graphics and Hewlett-Packard graphics workstations. Division has also just completed a Windows-hosted version of dVS to allow interworking between PCs and Unix workstations.

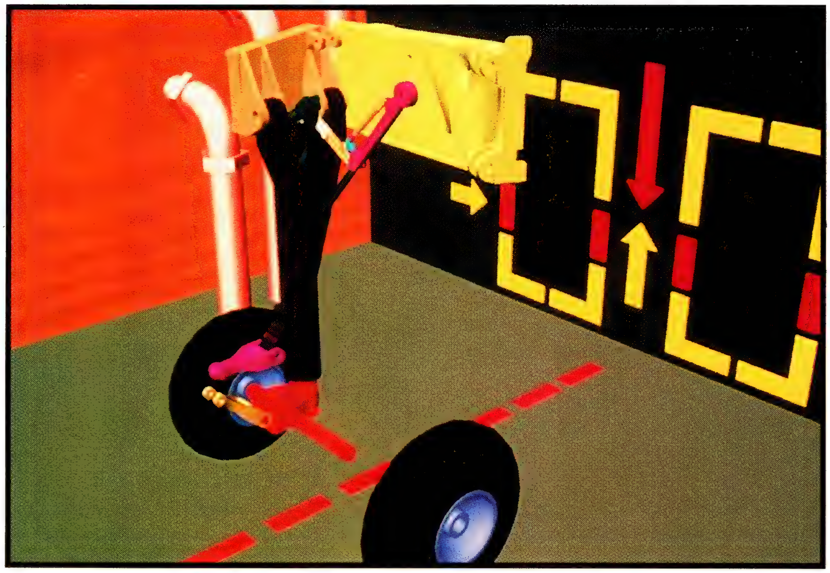
A distributed client/server system, dVS breaks down the task of supporting a virtual world in a more fine-grained way than RealiMation does. The dVS system contains several independent servers, called *actors*. You can run each actor on a different processor or processors. Separate actors are responsible for image generation (i.e., geometry and rendering), spatializing stereo audio, collision detection, Newtonian physics (i.e., implementing the laws of gravity, friction, and elasticity on moving objects), and input and output device control. The latter actor supports a variety of VR headsets and 3-D pointing and tracking devices.

Because dVS is a multiuser system, it enables several networked users to work together in the same virtual world. A separate actor, called the Body Actor, provides an interface to each participant in such a shared virtual environment. The Body Actor, assisted by Input and Collision Actors, monitors each participant's position and boundary attributes in real time. This multiserver architecture means that you can run user applications in parallel with the virtual environment. You can, for example, feed continuous data streams into dVS while visualizing them in real time.

The dVS system offers three choices for building applications. One tool is dVISE, an interactive authoring environment that runs on top of dVS and lets you build virtual worlds without programming; it comes with data-exchange interfaces for AutoCAD, 3D Studio, Wavefront, and MultiGen 3-D modelers.

The company sells extra converters for leading industrial CAD packages, such as Intergraph EMS, CADDS 4, IGES 5, and Dassault's CATIA. These converters enable you to directly import engineering drawings to build virtual models. The dVISE tool also contains an immersive VR editor that lets you go inside a virtual world, move objects around, and paint them. Using the editor, you can adjust attributes, such as sound and visibility, by selecting from a virtual menu of floating tool icons. You also can set conditional triggers for events.

Rather than building VR applications interactively in dVISE, you can write Virtual Data Interchange (VDI) scripts to define virtual worlds (you use traditional text editors and VDI notation to create the scripts). Finally, you can link your



Division's dVS lets companies verify parts clearances by using immersive VR systems rather than multimillion-dollar scale models.

Animation Is No Substitute for Virtual Reality

Where does animation end and virtual reality (VR) begin? The extraordinarily realistic animation used in such movies as *Jurassic Park* and *Toy Story* isn't VR, no matter how temptingly real the scenes look. Every time you watch *Jurassic Park*, you're seeing the same set of viewpoints—the ones that Steven Spielberg chose for you. By contrast, virtual reality is a "place" that you can enter, move through, and interact with at will.

What you see in a VR system is not a set of stored images, but rather a view—computed on the fly—onto a database of 3-D object data that describes the geometry and attributes of a virtual world. The VR software has to read your current position in virtual space, determine what objects should be visible from this viewpoint, read their coordinates from the database, and transform them into perspective. And, as if that's not hard enough, the software also has to render all the objects in real time—between 10 and 30 times per second, or around 50 milliseconds per frame.

In contrast, an animation is a fixed sequence of prerendered images that were rendered off-line and not in real time. For example, in the making of *Toy Story*, a network of 117 Sun workstations rendered each frame. Depending on its complexity, a frame could require between 2 and 15 hours to render. Animating the actors' faces took about a week for each 8 seconds of dialogue. Animators are free to use photo-realistic rendering techniques, such as ray tracing and environment mapping, that are not yet feasible for real-time VR systems (except on the most powerful platforms, such as the SGI Onyx/RealityEngine).

For VR systems, rendering speed is paramount to achieve an acceptable refresh rate without flicker. To this end, VR systems often use dynamic schemes that downgrade the level of detail rendered for distant objects or during rapid motion.

Nevertheless, VR and animation technologies have a lot in common, and they will converge more and more as rendering hardware becomes more powerful. You already can use the same 3-D modeling tools, including 3D Studio and TrueSpace, to create objects for use in either VR or animation.

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own C programs with Division's VC library, which gives you direct access to the dVS actors.

Bob Stone runs one of Europe's oldest VR firms, VR Solutions, which uses dVISE to deliver maintenance-verification systems to Rolls Royce and Vickers (for aircraft engines and nuclear submarines, respectively). These applications help designers check whether engineers can reach parts in confined spaces. "Vickers used to check clearances by building a one-fifth-scale plastic model, which was phenomenally expensive," Stone says.

The fully immersive VR systems cost, depending on development time, about $395,000 to $495,000. By contrast, the cost of a model ranged between $6.6 million and $13.2 million (even at one-fifth scale, they fill an airplane-hangar-size building). Using dVISE simplifies maintaining and managing the VR systems themselves. "I don't consider myself to be a programmer, but I can alter a model in dVISE," Stone says.

High-End VR

At the top end of the market, Multigen's new Smartscene delivers one of the most interactive VR authoring systems in the world. Multigen produces 3-D modeling tools for Silicon Graphics workstations and professional simulation systems from Evans & Sutherland and Lockheed/Martin. Its current customers include some of the world's biggest manufacturers, including Boeing, BMW, Chrysler, General Motors, and Volvo.

Smartscene is an advanced editor for assembling 3-D scenes from prefabricated parts. It's reminiscent of a fully immersive version of SimCity.

To use Smartscene, you wear a head-mounted VR display and a pair of special "Pinch Gloves," which have touchpads on each fingertip that act like mouse buttons when touched by the thumb. The two-handed interface allows you to interact with the objects inside Smartscene using the same kinds of hand movements and grips you would use for real-world objects. Your natural eye-hand coordination also comes into play.

The basic component tool sets that you work with appear as 3-D trays—which look somewhat like TV dinners—that you can hold in your hand while you search for the parts you need. Unlike in the real world, however, Smartscene objects all have 3-D handles that allow you to stretch and scale them or change their color or texture. There are also "hyper-real" shortcuts in this world: If you want to see the far side of something, you don't have to rotate the object manually. You just cross your arms, and the distant side turns to face you.

Don the VR display, and you see sets of prefabricated parts, called Smartkits, that appear to be attached to stalks, like the plastic components of a model-airplane kit. You select the part you need and then use the gloves to stretch and color the part to your requirements. Such parts have built-in intelligence, called ModelTime behavior; thus, when you place them roughly into position, they snap together in the right place. A tree, for example, will plant itself in a lawn and not atop a nearby roof. You can run scenes created in Smartscene under Silicon Graphics Performer software, and Multigen claims that Smartscene is a full order of magnitude faster at creating 3-D worlds than conventional editors.

An Interactive Future

Smartscene-style interactivity is currently available only on Silicon Graphics Indigo Impact workstations, but within a year or two you may see this level of graphics performance on Pentium Pro–based PCs with the new generation of 3-D accelerated graphics cards. Previously expensive peripherals, such as headset displays and data gloves, are beginning to fall in price, driven by the games market. Lightweight headsets, such as Virtual i-O's i-glasses, already sell for under $500.

Once this sort of power is available at PC prices, we will see VR applications bloom. Attendees at the CeBIT show earlier this year saw Vierte Art's Vuppet-Master application, which captures your facial expressions using a head-mounted video camera and merges them in real time onto any 3-D object displayed on an SGI workstation screen. If grafted onto a multiuser, immersive VR system, technology like this could revolutionize the effectiveness of VR as a tool for diverse uses, such as remote teaching, technical support, or phobia therapy, not to mention recreation. **B**

Proprietary Pinch Glove technology in Multigen's Smartscene lets you manipulate VR objects almost as if they were real-world objects.

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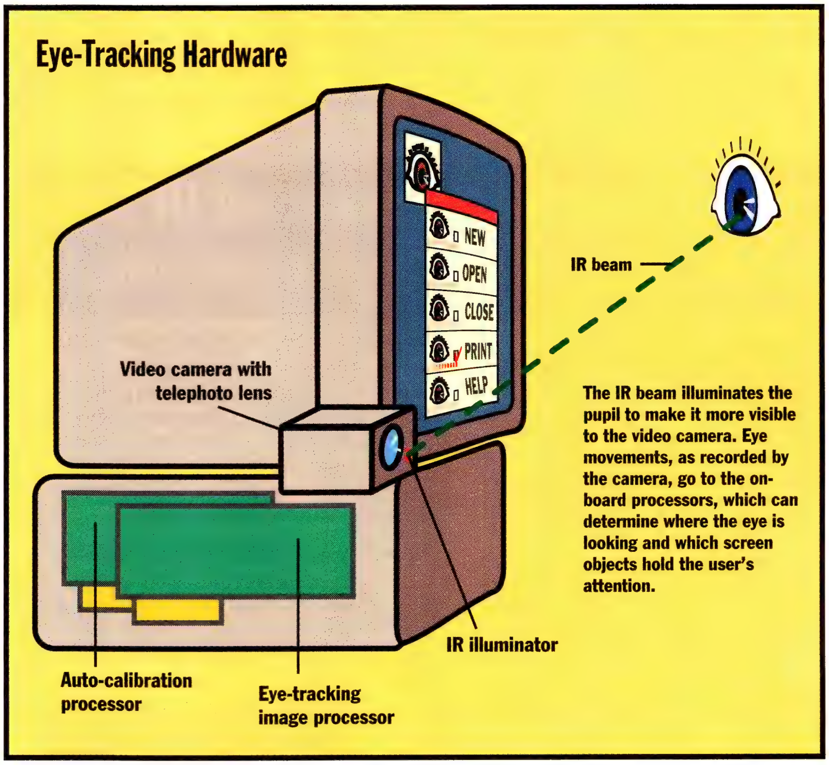
Eye-tracking technology can initiate an ongoing dialogue between you and your computer. ***By Alan Joch***

What Pupils Teach Computers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The IR beam illuminates the pupil to make it more visible to the video camera. Eye movements, as recorded by the camera, go to the on-board processors, which can determine where the eye is looking and which screen objects hold the user's attention.

Hands-free eye-tracking systems let people work 25 percent faster than they can when using a traditional mouse.

The next time you stare at your computer, your computer might be staring back. Not passively, like when a videoconferencing camera records your image, but actively, so that your computer watches your eyes scan the screen and waits for you to linger on an icon or menu item. The instant your eyes stop moving—250 milliseconds afterward, to be exact—the application that you want opens up, almost as if your computer were reading your mind.

A new generation of research using eye-tracking hardware and on-screen graphical symbols, dubbed *eyecons*, is happening in earnest in North America and Europe. "Easy" applications, such as hands-free command input for fighter pilots, historically have received the most research attention. However, now eye-tracking developers are tackling the really difficult work—making the technology efficient for general business applications.

Some benefits of eye tracking are obvious. Lab studies have shown that the technology lets you work about 25 percent faster than you can with a traditional mouse. Hands-free input also means no carpal-tunnel problems or tendinitis. What's more, eye tracking may be the only way for some disabled people to interact with a computer.

But researchers have their eyes on even bigger prizes. Some people think eye tracking is ushering in a new era of *non-command interfaces* that engage computers and humans in a continuous dialogue. Rather than waiting for you to issue discrete commands, these interfaces monitor body language to anticipate your next move, like a bass player accompanying a jazz pianist.

Eye tracking can be especially useful when you're browsing for information, whether it's application icons scattered across a screen or hot links throughout a Web document. However, the mouse will still reign once you're in a document and performing precise tasks, such as cutting and pasting.

When everything's going right, says Robert Jacob, an eye-tracking researcher since 1988, eye tracking feels like "the system is executing the user's intentions before he or she expresses them." But not everything works right all the time. Although commercial eye-tracking hardware has dropped in price from about $250,000 to $20,000 in the last eight years, the hardware can be unstable. A system that works well with one person might stumble when someone else sits at the computer. One explanation: People with naturally larger pupils have the greatest success with eye tracking.

That's because the pupil is the command center for most eye-tracking systems. Eye-tracking hardware shines an infrared beam into the user's eye to illuminate the pupil so that a custom video camera mounted on the computer can record the pupil image. Image-processing hardware digitizes the pupil image and turns eye movements into horizontal, vertical, and depth coordinates.

During the dark ages of eye tracking, humans had to use a bite bar to make sure their heads didn't move. Today's systems factor out head movement by reading a nonpupil reference, typically a point of light reflected from the cornea.

Hardware vendor ISCAN sells systems that consist of two AT-bus cards that plug into a standard PC or workstation and handle coordinate tracking and image processing (see the figure "Eye-Tracking Hardware" above). A video camera with infrared optics to capture the user's eye image can be mounted on the PC or attached to a lightweight headband. The headband includes a special mirror that the user can see through but reflects an infrared beam into the user's pupil; a cable connects the headband directly to the image processors in the PC.

Applied Science Laboratories sells similar systems. The company recently purchased technology from Daimler Benz, which has developed systems that can be used in bright-light conditions.

The basic hardware components of a rudimentary eye-tracking system are becoming commonplace on today's PC. For example, some PCs and Power Macs now ship with a video camera, built-in frame grabbers, and high-speed video processors. This equipment would need customization for eye tracking—video cameras for eye tracking require stronger telephoto capabilities than videoconferencing requires, for example—but the basic building blocks are there.

Eye-tracking hardware is only half the puzzle. Software will be the key to turning this specialized equipment into a workable input system for business applications. A key software component is the user interface management system (UIMS), which interprets eye positions and monitors the areas on the screen where a person focuses attention. A fixation algorithm turns these pauses, known as *dwell time*, into a discrete token, which is eye-tracking parlance for *events*. "We report tokens for the start, continuation, and end of each detected fixation," says Jacob, who began developing UIMS software at the Navy Research Laboratory and has moved to Tufts University to continue his work. His UIMS is written in C++ and runs under Unix.

In practice, the interface screen might be filled with application icons. You'd need to focus on an icon for only 150 to 250 ms before the eye-tracking system interpreted that dwell time as a command and opened the application.

In some early systems, eye movements controlled an on-screen cursor. But researchers have discarded that approach because users became annoyed by a blurred arrow that was always flying around within their field of vision.

Users haven't reported such problems as eyestrain while using these systems. However, some older hardware needed an IR light so strong that it dried out the tears of people wearing contact lenses. Others say that the systems are so fast and responsive that they try to avoid blinking for fear of missing something.

Will eye tracking dominate our desktops by the turn of the century? Probably not. Vendors and researchers believe our eyes will be only one component of future "multimodal input" systems.

When those systems come, we'll be gazing, talking, and pointing at our computers to give them commands. And in return, our computers will become more adept at deciphering how our bodies say what's on our minds. **B**

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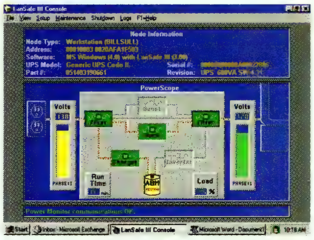
From PCs to mainframes, Deltec UPSs are, the price/performance leaders in the areas most important to users: reliability, ease-of-use, and customer support. Deltec's goal is to offer products with unique user benefits at very competitive prices.

How important is a broad product line?
Deltec's roots were established protecting critical mainframe applications. We now bring those advanced features to micro UPSs with the most comprehensive product offering available and factory trained service engineers throughout the nation.

How do you evaluate system reliability?
After more than 25 years as a technology leader end-users, independent test labs, and leading computer manufacturers alike have rated Deltec UPSs #1 in this vital area.



Node Type: Workstation (BILLSULL)
Software: MS Windows (4.0) with LanSafe III (3.00)
UPS Model: Generic UPS Code II
Power Monitor communications OK

Why is power management software important?
Protecting data is as important as safeguarding hardware. Deltec's power management software saves data throughout the network and ensures graceful shutdown during extended blackouts. LanSafe III and FailSafe III packages are compatible with all major operating systems — and work with Deltec's, as well as other manufacturer's, UPSs.

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Circle 94 on Inquiry Card (RESELLERS: 95).

STELLAR PERFORMANCE

"RUMORS ABOUT THE DEMISE OF 32-BIT SPARC PROCESSING HAVE BEEN GREATLY EXAGGERATED."

—Roger D. Ross

Much has recently been written about the "inevitable" migration of 32-bit SPARC workstations to a 64-bit computing environment. However, there are at least 10,000 good reasons why 32-bit SPARC technology remains robust. That's the number of useful SPARC applications generating profits for thousands of firms daily.

At ROSS, we will continue to invest our resources and ingenuity into advancing 32-bit technology because we believe that's what our customers want. It is a technology which has absolutely proven itself in the market.

Immediate migration to 64-bit computing forces 32-bit users to abandon huge software investments, move to an unproven OS, and incur new software and training costs. We expect most SPARC users will first look for timely answers to obvious questions:

- ***Will 64-bit systems run 32-bit software applications faster?*** In most cases, the answer is "No." A change in processing speed does not automatically deliver *any* gains in performance for applications. Often, 32-bit programs run slower on 64-bit systems. The correct economic and technical solution for accelerating 32-bit applications is high-performance hyperSPARC CPU upgrades and multiprocessing from ROSS.
- ***Will the software companies follow the shift in hardware?*** Eventually, but not for a few more years. So far, relatively few independent software vendors support the various 64-bit systems introduced since 1991; the volume of 64-bit applications needed for true 64-bit performance will take years to reach the market.
- ***But aren't there inherent advantages to 64-bit processing?*** For some very large computing problems, yes, but certainly not for a majority of workstation users, now or anytime soon.

At ROSS, we know many SPARC workstation users have critical data processing needs tied to 32-bit applications. While our own 64-bit processors are in development, we will not migrate from 32-bit processing until there is an established software base and clear market demand. And we will not allow our 64-bit development to compromise our 32-bit efforts.

In the end, it's your choice *when* you migrate or *if* you migrate. We believe there's superior value in the performance of ROSS' 32-bit hyperSPARC technology, now and for years to come. You make the call.

For more information, contact ROSS Technology at 1-800-774-ROSS (US), 512-349-3108 (Global), 512-349-3101 (Fax) or http://www.ross.com.

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Circle 96 on Inquiry Card (RESELLERS: 97).

AD_BYTE0596

Don't get caught in a network jam. Stay connected with one of the five fast, reliable remote-access servers tested here.

By Jim Kane and Dorothy Hudson

5 Reliable Servers for Remote Access

You're stuck in a hotel room in Salt Lake City, but you need to tweak a file that is on your firm's network server in Atlanta. Good luck if you're in a hurry, because any experienced road warrior can tell you that getting fast and reliable access to company resources from a remote site isn't yet up to speed. Indeed, weak remote-access performance is becoming a serious problem for many large firms that have telecommuters, small branch offices, and traveling executives. Network managers should take heed because the horde of nomadic workers is growing fast.

"There is a surge in telecommuting issues," says Marlo Kosanovich, an analyst for the Meta Group who specializes in remote access. "Clean air acts are forcing companies in cities like Los Angeles to start telecommuting options. Also, more people are working at home, and companies find that this saves them money by renting less office space. More traveling professionals than before are getting access to the network on the road."

For this reason, many network managers are turning to remote-access servers to improve network connectivity for those who work outside office walls. With a remote-access server, you can dial directly into the network over dial-up, ISDN, or leased lines. The server acts as a traffic cop, directing incoming messages to resources on the LAN. This way, telecommuters don't have to dedicate a system in the home office for remote-control access of a PC as long as their files are somewhere on the dial-up LAN. Also, the routers can act as sentinels for network administrators to manage protocols and security for remote access to the network.

Networking systems, particularly those including remote access, rely on complex—and sometimes fragile—interdependencies among their numerous component parts. Not only must each component of a remote-access system work well by itself, it must also integrate with the other components to provide a cohesive whole that works from end to end. Your remote-network calls must go through a gauntlet of modems, telephone lines, gateways, and the servers themselves before they reach the LAN. Everything has to click in a remote-access solution. Otherwise, remote users will become isolated islands in your firm's data stream.

BYTE BEST
REMOTE-ACCESS SERVERS

3Com's AccessBuilder 4000 comes out on top in raw performance and has what it takes to keep your connections running smoothly.

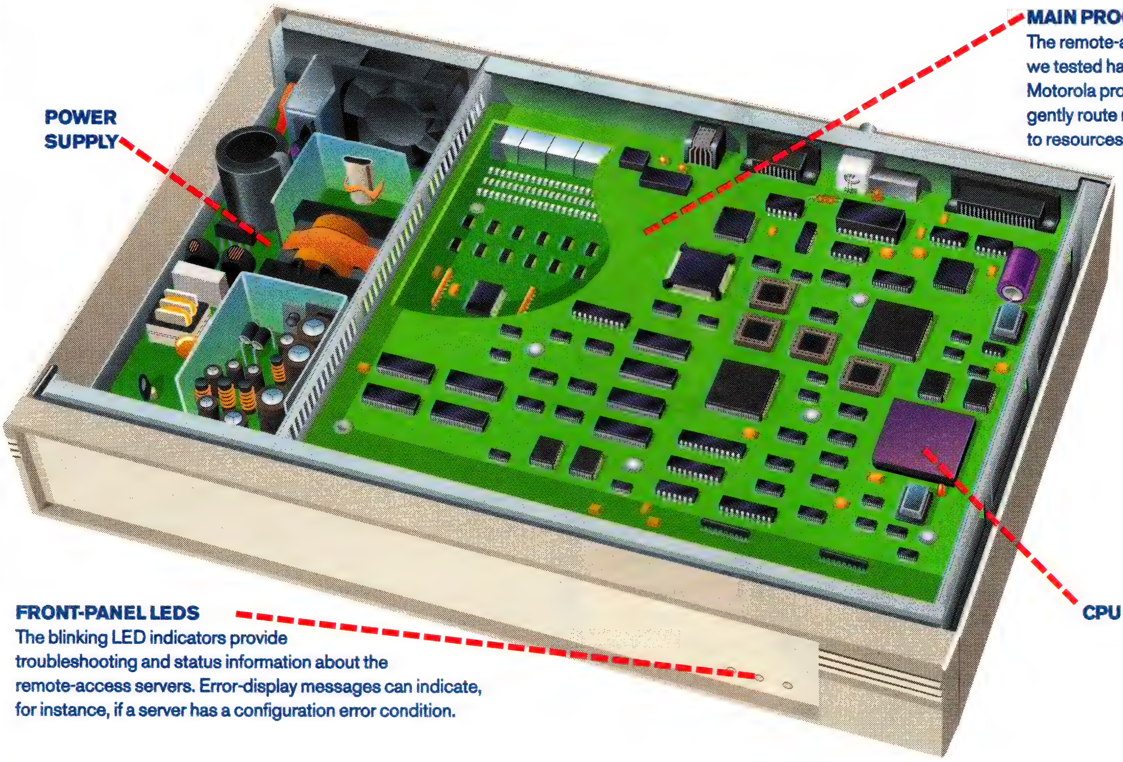
In this hardware roundup, we tested five eight-port remote-access servers. They range in price from $1095 to $4745 and—relative to other remote-access servers on the market—are low-end solutions because they are limited to eight or 10 ports. If only this number of remote users will access your LAN concurrently, they'll do the job. Otherwise, you'll need a more expensive 16-port (or greater) server, which most of the vendors offer. The servers enhance file transfer speeds, help users access company databases, and run enterprise applications that reside on the central LAN.

To be included for testing (see Test Specs on page 107), a remote-access server had to have eight simultaneous connections; have support for Novell NetWare 4.x (we tested with a NetWare server), Windows NT 3.51, IPX/SPX, and TCP/IP; and provide asynchronous data transfer rates of at least 115.2 Kbps. We based our evaluation mostly on performance because fast network access is a concern for remote-access users. However, for systems administrators, usability and features are important. Therefore, we weighed those two components almost as high as performance.

The Remote Possibilities

The five servers—3Com's AccessBuilder 4000, Digi International's AccelePort 8em, Emulex's ConnectPlus Pro, SBE's netXpand Central, and Shiva's LanRover/E—offer different architectures and price/performance levels. The routers use serial-port connections for external modems or have Type II or Type III slots for PC Card modems.

The servers all come with remote-access management software, and they have such security features as encrypted password protection, the Password Authentication Protocol (PAP), and the Challenge Handshake Authentication Protocol (CHAP). The major reason there are so many checks and challenges is security. Once you are authenticated by the router itself, you are then given the

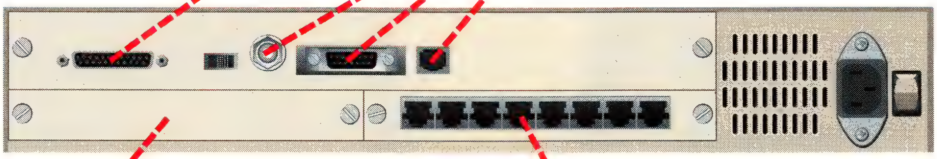


POWER SUPPLY

MAIN PROCESSOR BOARD The remote-access servers that we tested have RISC-based and Motorola processors that intelligently route remote-access calls to resources on the LAN.

CPU

FRONT-PANEL LEDS The blinking LED indicators provide troubleshooting and status information about the remote-access servers. Error-display messages can indicate, for instance, if a server has a configuration error condition.



SERIAL CONSOLE PORT An RS-232 console port is provided on the router's main processor board. You can connect a workstation running a terminal-emulation program to the port for installing, configuring, and monitoring your server.

LAN-PORT CONNECTIONS Attachment unit interface (AUI), BNC, and 10Base-T connectors plug into a remote-access server's on-board Ethernet port. Token-ring versions can provide connectors for shielded twisted-pair (STP) and unshielded twisted-pair (UTP) media connections.

OPTIONAL I/O CARD BAY Most remote-access servers leave room for you to add Ethernet ports or plug-in ISDN Basic Rate Interface (BRI) modules for faster ISDN services. You can also add high-speed synchronous interfaces for leased lines.

EIGHT-PORT ASYNCHRONOUS I/O CARD Most of the servers that we tested have eight ports to attach the routers to external or internal dial-out modems. Some routers provide slots for PC Card modems, and others use serial or RJ-45 ports for external modems.

ILLUSTRATIONS: SANDERS / TIKKANEN DESIGN & ILLUSTRATION © 1996

opportunity to attempt a network log-in.

Emulex's ConnectPlus Pro and SBE's netXpand Central are PC Card–based remote-access servers. The ConnectPlus Pro has four Type III PC Card slots, where users can stack eight Type II modems. There are also two WAN ports and one V.24 asynchronous port. The server has a 25-MHz Motorola MC68360 processor with a daughtercard slot for upgrades. The netXpand Central has eight Type II PC Card slots and two serial WAN ports. These servers obviously don't come with modems, but you can buy eight 28.8-Kbps modems for about $160 each, for an additional cost of $1280.

Digi International's AccelePort 8em is the lowest-cost remote-access server we tested. It consists of an ISA board that you install inside your network server with eight serial ports for external modems. The server uses an on-board processor to handle serial I/O interrupts, character processing, and data transfers.

Shiva's LanRover/E and the AccessBuilder 4000 use external modems for remote users to attach to the LAN. These are higher-cost solutions, but their high performance makes them well worth the price.

To test the remote-access servers (see Test Specs on page 107), we bombarded the routers with remote-access requests from eight users over regular analog telephone lines. The servers must direct the calls to applications, data, and personal file directories—something a telecommuter would do during a regular workday. For the best remote-access performance, we recommend ISDN- or T1-line connections, but as with the faster servers, the wider bandwidth will shrink your wallet.

continued

Contributors

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John McDonough, Technical Writer/NSTL
Maggi Bender, Technical Analyst/NSTL
Susan Colwell, Technical Editor/BYTE

Best Overall

REMOTE-ACCESS SERVERS

The number of users tapping in from afar for network resources has increased so fast that many market analysts predict an explosion in the sales of remote-access solutions in the next two years. The important thing to remember before buying a remote-access server is that remote access has many different looks. If you have a small traveling sales force that just dials in to check e-mail, remote-control software or an e-mail dial-in gateway and a fast modem in a laptop are fine. You have to make the jump to a router if you have telecommuters who regularly dial in for file transfers, use enterprise-wide applications, or frequently access your firm's database.

We tested the five servers (see Test Specs on page 107) as if they were set up for telecommuters dialing in over analog telephone lines using V.34 modems (28.8 Kbps). We found that we could not saturate the routers because of the limited bandwidth bottleneck of the modems. Even the fastest V.34 modems that have a clean 28.8-Kbps connection—which support 155 Kbps with data-compression schemes—are just a pinhole in a clogged artery when compared to 10-MBps direct-LAN Ethernet connections.

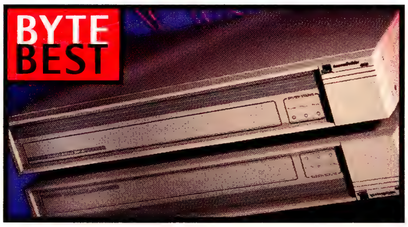
If you want better performance, you should try to set up remote users with wider-bandwidth ISDN or T1 lines. The downside of that is the $1000 price of ISDN modems plus maintenance of ISDN lines compared to cheaper V.34 modems transmitting over standard telephone lines.

Our hands-on experience with the remote-access servers tells us that their main use is to efficiently manage and route calls through the network. The servers are far more easy to manage than remote-control PCs. With Password Authentication Protocol (PAP) and Challenge Handshake Authentication Protocol (CHAP) security and callback capabilities, these remote-access servers will make any network administrator sleep better at night. The servers give network managers tighter control of resources and tighter security, which any administrator can tell you are major problems with remote-control access.

3Com's AccessBuilder 4000

The AccessBuilder 4000 ($4745), our choice for best-overall server, is the most feature-filled server we tested. It can handle mixed asynchronous, synchronous, and ISDN technologies simultaneously. Remote PC, Mac, and Unix-based clients can dial in simultaneously via analog modems, ISDN, or Switched-56 data-service-unit (DSU) lines. The system accommodates any mixture of four- or eight-port asynchronous WAN modules or a single-port T1/E1 (1.54 to 2.05 Mbps) synchronous module for high-bandwidth connections. The AccessBuilder 4000 has an Intel 960 processor, and intelligent asynchronous cards reduce protocol processing overhead to further enhance its performance.

As the network expands, you can install additional AccessBuilder servers and ports to provide more accessibility. The company provides software for centralized management and offers security facilities. For Ethernet connections, attachment unit interface (AUI), BNC, and RJ-45 connectors provide links to thick- and thin-wire Ethernet and 10Base-T twisted-pair wiring.



Remote users can opt for either AccessBuilder's own Windows, DOS, or OS/2 client software or third-party PPP and SLIP client packages, including Windows 95 and NT dial-up clients. AccessBuilder's client utilities include an integrated phone book and multiple icons for dialing frequently accessed sites. AccessBuilder's built-in security prevents unauthorized network access through password protection and PAP and CHAP schemes. Automatic callback caller identification denies access to unauthorized ISDN calls. The Windows-based management software was easy to learn and use, allowing detailed configuration of each port, as well as user management.

Digi International's AccelePort 8em

At $1095, Digi International's AccelePort 8em is the lowest-cost solution of the five remote-access servers. It's an internal/external solution with an ISA-based add-in card that you install inside your LAN server connected to an external box that has eight serial-port connections for external modems. This direct-to-LAN-server attachment may be cost-effective, but it takes its toll on your server.

Although the other routers stayed in the area of 3 percent to 8 percent CPU utilization during our performance tests, the AccelePort 8em router regularly used 12 percent to 15 percent of our NetWare server, with occasional 100 percent spikes. On an already-busy network, this will degrade network performance during remote-access dial-ins.

Digi bundles the NetWare Connect 2 software suite with the AccelePort 8em. NetWare Connect 2 lets up to 128 remote DOS, Windows, and Mac users dial in and access information on a NetWare LAN. As a NetWare loadable module (NLM), the application uses the security features of NetWare, including NetWare Directory Service (NDS), log-in, password, and audit capabilities.

We found some problems unique to Digi's server. First, to install the server's I/O card, you have to shut down the server and interrupt network activity in the office. This is soon forgotten after the server is taking calls, but it is inconvenient for users

PHOTOGRAPHS: LIGHTWORKS PHOTOGRAPHIC, INC. © 1996

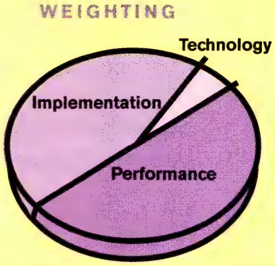
LAB RESULTS

REMOTE-ACCESS SERVERS RATINGS

BEST OVERALL

3Com's AccessBuilder 4000

3Com's AccessBuilder 4000 provides the fastest network throughput in our benchmarks, where we bombarded the servers with multiple remote-access sessions. Available in both Ethernet and token-ring configurations, the AccessBuilder 4000 supports both analog and digital (ISDN) technologies, as well as multiple protocols. 3Com's Personal Routing system software architecture gives remote-node clients the same functionality as local nodes—with not quite the speed of a local connection.



	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	USABILITY	FEATURES	OVERALL RATING
3Com AccessBuilder 4000	**$4745**	★★★★	★★★★	★★★★★	★★★★	★★★★★	★★★★
Shiva LanRover/E	$4199	★★★★	★★★★	★★★★	★★★★★	★★★★	★★★★
SBE netXpand Central	$1899	★★★★	★★★★	★★★★	★★★★★	★★★★	★★★★
Emulex ConnectPlus Pro	$2895	★★★★	★★★	★★★★	★★★★	★★★	★★★★
Digi AccelePort 8em	$1095	★★★	★★★	★★★★	★★★	★★★	★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

on the LAN. Also, subpar user manuals lowered the usability score of the AccelePort 8em; in fact, most of the documentation is from Novell. Also, regarding installation, we felt a little uncomfortable using the semiautomated product installation (Novell's INSTALL.NLM), and this required several technical-support sessions.

Emulex's ConnectPlus Pro

The ConnectPlus Pro ($2895) has the classic flat, stackable chassis with four Type III PC Card slots that you can insert eight Type II modems into. There are also two WAN ports and one V.24 asynchronous port. The ConnectPlus Pro has a 25-MHz Motorola MC68360 processor and has a daughtercard slot for future upgrades. The server's performance was slightly better than that of SBE's netXpand Central.

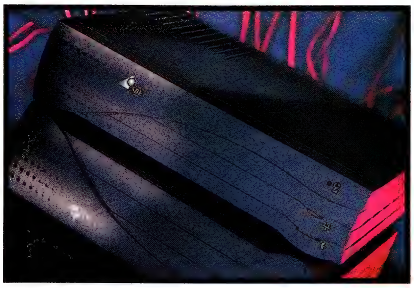
Future software upgrades are accommodated via the server's 4 MB of DRAM, 2 MB of flash memory, and 1 MB of boot PROM. The server provides multiprotocol dial-in support over PPP for NetWare (IPX) and Unix (TCP/IP) users. The server is compatible with major TCP/IP packages, including NetManage's Chameleon, Novell's Workplace, FTP Software's PC/TCP, or any PPP-compatible TCP/IP stack. The server's Windows-based software is designed for NetWare (IPX) remote-node dial-in users.

The Windows Manager software lets network managers configure and manage the server via IP or IPX clients. The tab-based software is easy to use and learn.

SBE's netXpand Central

SBE's netXpand Central is a relatively low-cost ($1899) remote-access server. It has eight Type II PC Card slots. Two serial ports support T1/E1 lines for 10 simultaneous WAN connections. The stylish box routes TCP/IP and IPX protocols, bridges other protocols, and supports PPP for WAN interoperability. This was one of the easiest servers to set up, and it came in second in the usability rating because its documentation is clear and concise, and its tab-based software is easy to learn and use.

The netXpand Central includes Windows-based software for configuration, administration, and remote access. SBE updated its remote-access software earlier this year with the Prime option ($150), which provides more advanced routing features. Prime's key features include data compression on ISDN ports for faster throughput, modem pooling, chat scripting for remote dial-up services from Internet service providers (ISPs), and firewall filtering. Standard security features are PAP and CHAP, restricted callback, and password ID.



Shiva's LanRover/E

Shiva's LanRover/E ($4199) received the highest usability rating and came in second in performance. We just had to plug in the modems to the server's eight serial ports. Additional configuration was necessary to let users access the network, but Shiva's Network Manager software made this easy.

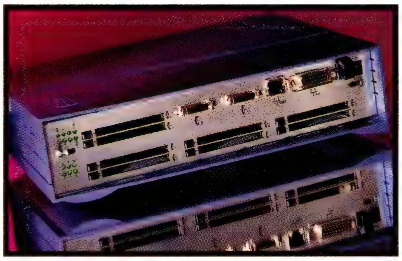
Shiva upgraded its remote-access software (ShivOS) this spring with version 4.0. It adds integrated ISDN to the remote-access solution, which lets network managers manage analog and ISDN multiprotocol access to private LANs, intranets, and the Internet in one integrated platform. Shiva offers integrated ISDN Basic Rate Interface (BRI) hardware modules for the LanRover/Plus servers.

continued

Details

Hot Looks, Nice Voice

While most remote-access servers look like your average flat hub that you hide in a network closet, SBE's netXpand Central has a sexy chassis with some curves in it. You can lay the purple box on its side, or you can set it upright with pedestal-like feet for the vertical look. The netXpand Central also has a voice-assist feature that reports the router's status to you. When there is an error, a voice says a number that you look up in the user's manual to troubleshoot the problem. It also adds sound effects when you remove or plug in a modem from one of the server's ports.

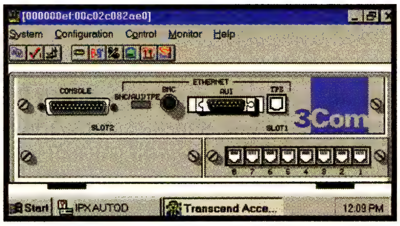


Shiva Secures Remote Win 95 Clients

Windows users concerned with security should check out Shiva's Windows 95 Security Pack, which provides roaming dial-back and change password features. The security kit lets remote users modify dial-back phone numbers as they move from location to location and enables the end user to modify a password as often as necessary, eliminating forced static authorization. Shiva helped Microsoft develop the dial-up networking client in Windows 95, and the Windows 95 Security Pack is the first in a series of enhancements to extend the remote-access functionality in Windows 95. It is bundled with ShivaOS and available on Shiva's Web site (www.shiva.com).

GUIs

All the remote-access servers have helpful Windows-based software utilities that are a big improvement over command-line interfaces. For instance, the Transcend AccessBuilder Manager (TABM) configuration utility that comes with 3Com's AccessBuilder 4000 provides an external view of an AccessBuilder server showing the status of any installed ports. There are instances when you must use the command-line interfaces, but you can use TABM to set passwords and install new servers, and you can pop up on-line help when necessary.



AirSoft's Powerburst 2.0 to Boost Remote Access

The remote-access servers we tested can improve network-access speed, but if you need an extra boost, try AirSoft's Powerburst. It uses a client/agent design to cache frequently used files on the remote user's client system. This strategy enhances performance because most network transmissions are redundant and might as well remain in the user's cache instead of clogging the modem connection.

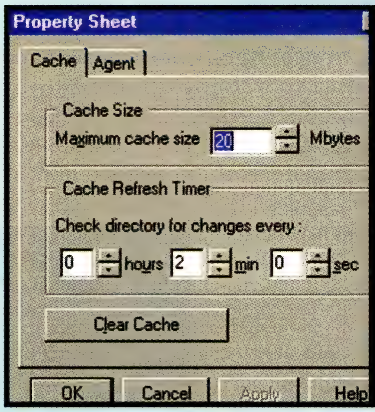
With Powerburst, which supports Windows NT and NetWare servers, you have Windows-based client software and a DOS-based agent that resides on a dedicated system attached to the home office's LAN server. Powerburst creates a 10-MB cache on the client's local hard drive the first time the remote workstation accesses a file on the server. Operating in tandem, the Powerburst client and agent apply caching algorithms to examine transmissions and eliminate the redundant file-system calls.

AirSoft claims that Powerburst (version 2.0 was released this spring with Windows 95 client software) increases application response time by 200 percent to 400 percent for remote-node access to LAN-based files. We can't verify this dramatic promise, but any performance improvements that Powerburst provides would mean that remote users would finish working and disconnect to free up remote ports for others.

The nice thing about Powerburst is that it requires few or no changes to your network or remote-node server configuration. It is compatible with most file-server environments, remote-node servers (e.g., Cisco, Shiva, 3Com, and Novell), and all remote-access media, including the Public Switched Telephone Network (PSTN), ISDN, frame relay, and others.

Powerburst agent software is available for $995. Each agent is capable of supporting up to 64 simultaneous users. Powerburst client software is available in multiuser licenses, starting at $645 for a five-user pack and ranging up to $245,000 for a 5000-user license.

–John McDonough



Cache Size

Maximum cache size 20 Mbytes

Cache Refresh Timer

Check directory for changes every:

0 hours 2 min 0 sec

Powerburst's client/agent architecture caches frequently used data on the remote user's hard drive.

Powerburst 2.0
$645
for a five-user pack

AirSoft, Inc.
Cupertino, CA

(408) 777-7500
fax: (408) 777-7527

www.airsoft.com

Circle 162 on Inquiry Card.

Test Specs

We based our evaluation mostly on performance because fast network access is a big concern when choosing a remote-access server. We also, however, placed a strong weighting on usability and features, and then we looked at technology and value. Our best-overall rating formula breaks down this way: technology (10 percent), implementation (40 percent, which is further divided into 40 percent for usability, 40 percent for features, and 20 percent for value), and performance (50 percent).

The performance test suite simulates from one to 16 remote users attempting to dial into a centralized LAN through the servers. To simulate multiple remote-access sessions, we had eight Windows 95–based Dell Dimension XPS P75 PCs dialing into the servers using Hayes Microcomputer Products' ((770) 840-9200) 28.8-Kbps Optima V.34/V.CF +fax +voice modems. The servers would then route the calls to a NetWare-based file server. The client-side systems were configured with 16 MB of RAM. We used telephone-line simulators from Northeast Innovations ((603) 229-0500) to create dial tones.

NSTL's InterMark file-access tests force the servers to seek files in the following three file directories:

- Applications—This directory has read-only access, and we use it the most in the tests. For this reason, it tends to remain in a remote-access server's cache memory.

- Data—This directory is much longer than the applications directory, so its individual files aren't used as frequently. Typically, a server doesn't cache these files.

- Personal—This directory simulates where you must go to access a personal file; the primary traffic to this directory is to write files. The tests in this directory also accommodate print traffic, which goes into a server's print queue.

To round out the evaluation, we rated usability and features. We checked out how easy the routers are to set up and use, and we weighted important features like customer support and warranty length.

Evaluations in this report represent the judgment of BYTE editors, based on tests conducted by NSTL, Inc., as documented in a recent issue of their monthly PC Digest. *To purchase a copy of the full report, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; on the Internet, editors@nstl.com. For a subscription, call (800) 257-9402. BYTE magazine and NSTL are both operating units of the McGraw-Hill Companies.*

Remote Connectivity in the Palm of Your Hand

If you need remote connectivity for your small business or workgroup but can't afford the high-end hardware solutions available, you should look at RouteMan from SBE's netXpand series. At $599, RouteMan is an inexpensive router, hub, and remote-access solution.

RouteMan is ideal if you need to expand your remote capabilities beyond the single-client-to-LAN connections you find using the even less expensive (around $100 to $150) remote-control or remote-node software solutions, such as Funk Software's ((617) 497-6339) Proxy and WanderLink, Stac Electronics' ((619) 794-4300) ReachOut 5.0, Symantec's ((408) 253-9600) pcAnywhere, and Traveling Software's ((206) 483-8088) LapLink.

RouteMan
$599

SBE, Inc.
San Ramon, CA

(510) 355-2000
fax: (510) 355-2020

www.sbei.com

Circle 1063 on Inquiry Card.

SBE's RouteMan combines a router, a four-port 10Base-T Ethernet hub, and remote-access capabilities in a tiny box.

Weighing in at only about 1 pound and consuming 10 W of power, RouteMan provides client-to-LAN and LAN-to-LAN connections through a PC Card slot. The slot supports either a high-speed modem card or an ISDN card (up to 128 Kbps per channel). RouteMan also includes an integrated four-port 10Base-T Ethernet hub, which lets you set up an entry-level network so you can share resources and connect an intranet server.

RouteMan supports multilink PPP, IP traffic-sensitive dialing, and installation and configuration utilities for Windows 95 and NT PCs, as well as Windows 3.1x. It can asynchronously transfer data at a rate of 115.2 Kbps. If security is a concern, RouteMan provides Password Authentication Protocol (PAP), Challenge Handshake Authentication Protocol (CHAP), and restricted callback. With RouteMan, SBE includes a software package called Workshop, which lets you easily configure the device and track network log-ons to monitor and record who has accessed your network.

If you think you're going to branch out onto the network even more, SBE also offers RouteMan XL ($749 until September 1). It includes all the standard features found in the basic model, as well as SBE's Prime software package, which offers modem pooling, high-speed data compression for ISDN, IPX traffic-sensitive dialing, IPX session emulation to minimize line charges, and chat scripting for remote dial-up services.

–Susan Colwell

REMOTE-ACCESS SERVERS FEATURES

Vendor/model	**3Com Corp. AccessBuilder 4000** BYTE BEST	**Digi International, Inc. AccelePort 8em**	**Emulex Corp. ConnectPlus Pro**	**SBE, Inc. netXpand Central**	**Shiva Corp. LanRover/E**
Price as tested	$4745	$1095	$2895	$1899 (plus eight 28.8-Kbps PC Card modems)	$4199
Base price (MSRP)	$2495	$1095	$2895	$1899	$3099
Overall rating	★★★★	★★★	★★★★	★★★★	★★★★
NETWORK REQUIREMENTS					
LAN topology	Ethernet, token ring	RS-232	Ethernet	Ethernet	Ethernet, token ring
IP address	✔		✔		✔
Modems	External	External	PC Card, external	PC Card, external	External
DSU/CSUs		One/support		✔ (for dedicated lines)	
Custom cables	RJ-45/DB-25			SBE EIA-232E, EIA-530A, or V.35 cable	
CONSOLE SPECIFICATIONS					
PC or ASCII	ASCII	ASCII	Both	PC	N/A
Port type	RS-232	RS-232	PC Card, RS-232	PC Card, serial	DB-25
Number and type of phone lines supported	Eight analog	Eight RJ-45	10 analog	10 analog, 10 ISDN, two leased line	Eight analog/digital
Dimensions in inches (W × L × H)	17 × 11 × 2.5	3.7 × 11.2 × 0.6	17 × 10.75 × 1.75	9 × 11.25 × 3	17 × 10 × 1.7
Weight (lbs.)	12	9 oz.	4.4	5.2	7.8
LINK SPEEDS					
Asynchronous (Kbps)	115.2	115.2	115.2	115.2	115.2
Synchronous	T1/E1	N/A	128 Kbps	T1/E1	N/A
MISCELLANEOUS					
NOS support	All	Windows, NetWare, IBM, SCO Unix, Solaris, Unixware, Xcellenet, Cheyenne, Citrix, Stampede	NetWare, Windows for Workgroups, Windows NT	All	NetWare, Windows NT, AppleTalk
Connections	Eight RS-232, RJ-45, or DB-25; 10Base-2, 10Base-T, AUI	Eight to 64 RS-232, RJ-45, or DB-25; DTE	Eight PC Card, Two RS-232	Eight PC Card, two serial	10Base-5, 10Base-2, 10Base-T
AC input (V)	90 to 220		110/220	110/220	90 to 264
ROUTER					
Expansion slots	Two proprietary	One ISA	One proprietary	N/A	N/A
Memory	512 KB x 4 on ISDN BRI/1 MB flash x 4 MB DRAM	One MB	4 MB expandable	1 MB standard	128 KB EPROM, 2 MB battery-backed SRAM
Processor	68302 x 4 on ISDN BRS/20-MHz Intel 960	16-MHz RISC 3051	Motorola 68360	68360 QUICC	16- or 25-MHz 68EC020
Serial ports	One to 16	Eight to 64	One	10	Eight
Status LEDs	✔	✔	✔	✔	✔
Tones (indicator)				✔	
SOFTWARE SPECIFICATIONS					
Routing	IP, IPX, ARAP			TCP/IP with RIP and/or static routes; IPX with RIP and SAP	IP, IPX, AppleTalk
Bridging	One/all protocols			All protocols	LLC/802.3, NetBEUI
WAN services	PPP, SLIP			PPP, multilink PPP	
Management (platform)	Transcend Access-Builder Manager		SNMP	SNMP manageable	Shiva Net Manager and SNMP
Security	Password, user name, dial-back, callback, Windows NT, NetWare Bindery, TACACS+, PAP, CHAP, ISDN caller ID, network filters, third-party	Provided by OS	Password, PAP, CHAP, dial-back secure ID	PAP/CHAP, restricted callback, optional firewall	Password, user name, dial-back, centralized authentication, NetWare Bindery, Security Dynamics ACE/server, Digital Pathways Defender Server, TACACS, AppleTalk zone and device filtering
NETWORK PROTOCOL SUPPORT					
TCP/IP	✔	✔	✔	✔	✔
IPX/SPX	✔	✔	✔	✔	✔
NetBEUI	✔	✔		✔	✔
NetBIOS	✔			✔	✔
Other	DECNet, Banyan Vines, AppleTalk, XNS, and other 802.3				
CUSTOMER SUPPORT					
Warranty length (years)	90 days/P,L,F,R	Five/P,L,R	One/P,L,F,R	Lifetime/P,L,R	One/P,L,R
Phone	(408) 764-5000	(612) 912-3444	(206) 881-5773	(510) 355-2000	(508) 788-3061
Toll-free phone	(800) 638-3266	(800) 344-4273	(800) 590-5773	(800) 925-2666	(800) 977-4482
On-line address	www.3com.com	www.digi.com	www.emulex.com	www.sbei.com	www.shiva.com
Inquiry no.	**1073**	**1074**	**1075**	**1076**	**1077**

BYTE BEST = BYTE Best

✔ = yes;
N/A = not applicable.

Warranty: P = parts; L = labor;
F = freight to repair center; R = return to customer.

★★★★★ Outstanding ★★★★ Very Good ★★★ Good
★★ Fair ★ Poor

RUGGED PORTABLES WITH LOTS OF SLOTS

Dolch Computer Systems builds portable computers for industrial and military applications that must withstand the rigors of rough treatment and harsh environments — demanding massive expansion capability and the performance of a high-end desktop.

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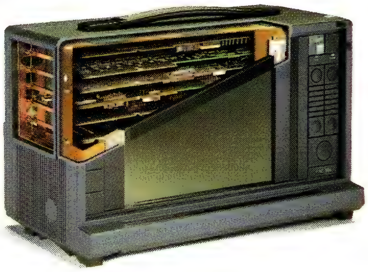
- ☐ Completely Sealed Systems — NotePAC™ Runs in the Rain
- ☐ Add-in Protection — Unique Card Retention System

MASSIVE EXPANSION



The PAC™, L-PAC™ (Light-PAC) and NotePAC families offer a wide variety of slot and drive specifications. Systems can be tailored to precisely match the application requirements.

- ☐ From 1 to 7 Expansion Slots — ISA, EISA, PCI and PCMCIA
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- ☐ Configurable System Power — 100 watts to 350 watts

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- ☐ CPU Options — 486 up to Dual Pentium at 150MHz
- ☐ Displays — 16.7 Million Colors or Daylight Readable Mono
- ☐ Active Matrix TFT Screens — Up to 12.1-inches
- ☐ Resolution — 640 x 480, 800 x 600 and 1024 x 768
- ☐ Graphics Performance — In Excess of 115 WinMarks™
- ☐ Drives — EIDE or High-speed PCI SCSI — Up to 9 GB
- ☐ Memory — High Speed Cache and EDO DRAM

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Six Comm Programs That Speak Windows 95

As computing becomes more enmeshed with communications, the software that manages your dial-up and Internet connections has to work harder. Under Windows 95, it can work smarter, too. ***By Tadesse W. Giorgis***

Getting two computers to exchange greetings and messages has always been two parts RTFM (read the freakin' manual) and one part magic. An important factor in improving communication, at least for Intel-based PCs, is Windows 95, with its new Telephony API (TAPI) and 32-bit universal modem (Unimodem) drivers. But Windows 95 also challenges third-party software developers to add value to their offerings.

BYTE and NSTL took a detailed look at six comm products for Win 95. We chose programs that offer at least three file-transfer protocols: ASCII, Zmodem, and Kermit. That narrowed the list to six: Delrina's CommSuite 95, Hayes' Smartcom Message Center, Mustang Software's QmodemPro for Windows 95, Datastorm's Procomm Plus 3.0, Symantec's pcAnywhere32 for Windows 95, and Hilgraeve's HyperAccess 2.1.

All offer direct dial-up connection or connection via a shared network modem, host and terminal support, file transfers, and chat sessions. All support several standard protocols, offer from 10 to 35 terminal emulations, and use the 16550 FIFO buffer (when available) for quicker transfer over high-speed modems. Only half the products do virus checking during file transfer, and few provide complete data encryption support.

Delrina's CommSuite 95

By the time NSTL had finished its tests, there wasn't much doubt as to which product came out on top. Delrina CommSuite 95's inclusion of almost every communications feature you could think of, combined with excellent performance and a first-rate implementation, made it the clear winner.

CommSuite is made up of four modules: WinComm Pro 7.0 for general data communications, WinFax Pro 7.0 for faxing, TalkWorks for advanced telephony, and Cyberjack for connecting to the Internet. WinFax Pro combines fax sending/receiving and built-in OCR with e-mail, paging notification, and voice messaging. TalkWorks, the telephony option designed to be used with a voice-capable modem, can turn a PC into a message center. Cyberjack 7.0, with its unique Guidebook, makes connecting to the Internet very easy. It includes all the popular Internet tools, including a Web browser, Usenet news, FTP, IRC, Gopher, Archie, telnet, Ping, and Finger. WinComm Pro offers general-purpose data communications facilities for connecting to BBSes and on-line services. WinComm Pro supports hundreds of different modems and the most common file transfer protocols and terminal emulations. It includes an image manager, a virus detector, a compression manager, along with a number of other tools.

BYTE BEST
COMMUNICATIONS

Delrina's CommSuite 95 bundles several powerful communications applications with excellent file transfer performance, versatility, and an easy interface.

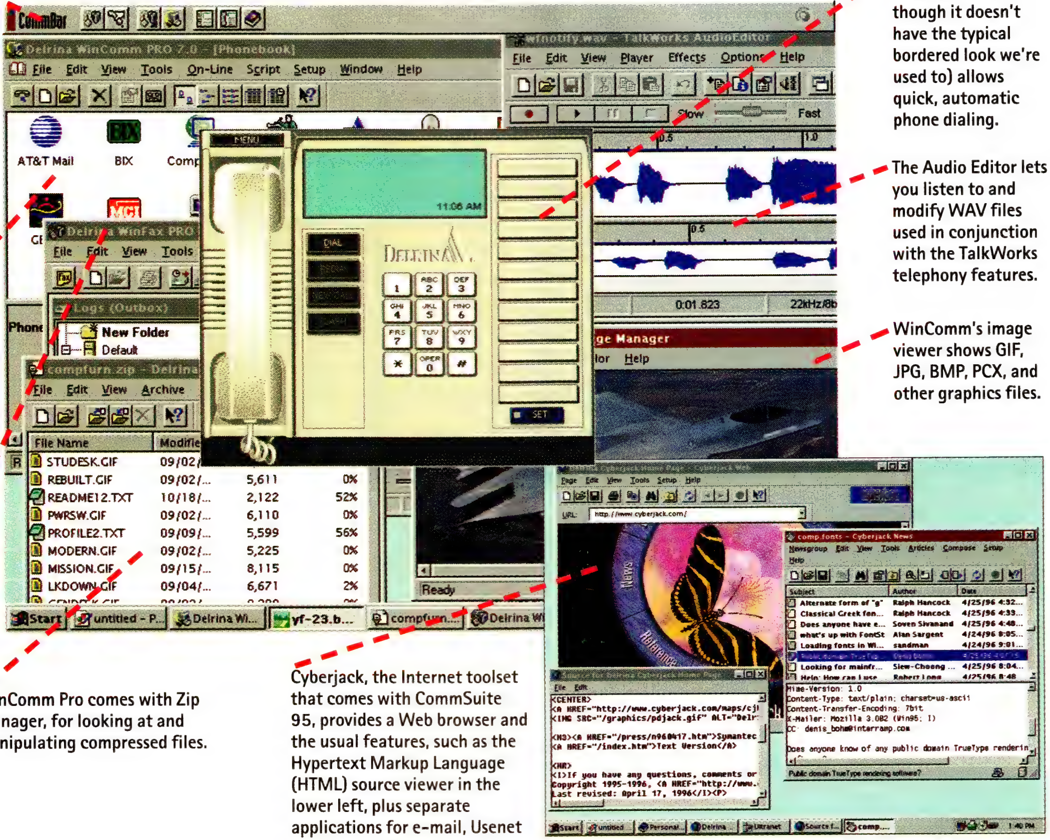
CommSuite 95 does not yet have a common interface from which to launch different application modules. But it is by far the most complete package in terms of component modules, and these modules work in a fairly consistent fashion.

Hilgraeve's HyperAccess

From the folks who wrote the HyperTerminal program included with Windows 95, you'd expect something pretty special. And you'd be right. High performance, achieved through a thorough understanding of what happens across phone lines, makes Hilgraeve's HyperAccess the fastest comm program of all those we tested.

HyperAccess 2.1 offers an uncomplicated user interface with simple but meaningful icons. The program is easy to learn and use, is very fast, and is very versatile. The logical menu structure and intuitive commands guarantee usability. The program comes with a comprehensive host mode and editor, a proprietary protocol with on-the-fly compression, and ISDN support. A built-in file manager displays directories and lets you find, print, copy and delete files. The integrated HyperGuard virus filter safeguards a remote system from infection during file transfers.

HyperAccess provides several tools for automating repetitive tasks. You can create automatic sequences, such as waiting for prompts from a remote system and sending a response, waiting for a certain time of day before executing a series



File Name	Modified		
STUDESK.GIF	09/02/		
REBUILT.GIF	09/02/...	5,611	0%
README12.TXT	10/18/...	2,122	52%
PWRSW.GIF	09/02/...	6,110	0%
PROFILE2.TXT	09/09/...	5,599	56%
MODERN.GIF	09/02/...	5,225	0%
MISSION.GIF	09/15/...	8,115	0%
LKDOWN.GIF	09/04/...	6,671	2%

Subject	Author	Date
Alternate form of "g"	Ralph Hancock	4/25/96 4:32...
Classical Greek fon...	Ralph Hancock	4/25/96 4:33...
Does anyone have e...	Soven Sivanand	4/25/96 4:48...
what's up with FontSt	Alan Sargent	4/24/96 8:05...
Loading fonts in Wi...	sandman	4/24/96 9:01...
Looking for mainfr...	Siew-Choong ...	4/25/96 8:04...

```
Mime-Version: 1.0
Content-Type: text/plain; charset=us-ascii
Content-Transfer-Encoding: 7bit
X-Mailer: Mozilla 3.0B2 (Win95; I)
CC: denis_bohm@interramp.com

Does anyone know of any public domain TrueType renderin
```

```
<CENTER>
<A HREF="http://www.cyberjack.com/maps/cj
<IMG SRC="/graphics/pdjack.gif" ALT="Delr

<H3><A HREF="/press/n960417.htm">Symantec
<A HREF="/index.htm">Text Version</A>

<HR>
<I>If you have any questions, comments or
Copyright 1995-1996, <A HREF="http://www.
Last revised: April 17, 1996</I><P>
```

CommSuite 95's optional Commbar, at the top of the screen, gives you immediate access to the major program modules without cluttering up the desktop. As with most similar toolbars, you can extend it to include other program-launching icons.

The phonebook window of WinComm Pro has icons for popular on-line services and allows you to set up as many other numbers as you like.

WinFax Pro's main window provides quick access to fax sending, receiving, and reading, and it provides for easy file management.

WinComm Pro comes with Zip Manager, for looking at and manipulating compressed files.

Cyberjack, the Internet toolset that comes with CommSuite 95, provides a Web browser and the usual features, such as the Hypertext Markup Language (HTML) source viewer in the lower left, plus separate applications for e-mail, Usenet newsgroups (shown here at right), FTP, Archie, Gopher, and other Net services.

The main TalkWorks window (even though it doesn't have the typical bordered look we're used to) allows quick, automatic phone dialing.

The Audio Editor lets you listen to and modify WAV files used in conjunction with the TalkWorks telephony features.

WinComm's image viewer shows GIF, JPG, BMP, PCX, and other graphics files.

Although you'd probably never run all these components at the same time, there isn't much in the world of communications you can't handle with Delrina's CommSuite 95.

of commands, or customizing terminal-interaction procedures.

HyperAccess offers many unique programming features, including a powerful macro mode that learns, deciphers, and optimizes user interaction with the program. This learn mode remembers log-on procedures, often-used key sequences, entire calls, and even procedures used during remote control operations. HyperAccess then generates a C program that it can execute with its built-in C language interpreter. Or, you can create custom programs using any programming language that can call external functions.

NSTL testers found HyperAccess' graphical-mode file transfer the easiest to use. It's simple and easy to specify files and start the transfer. And when there are errors, HyperAccess usually resets itself fairly well.

Datastorm's Procomm Plus 3.0

Since before Windows existed, Procomm has been handling communications for PC users. This long experience is reflected in the fast file transfer speeds and the wealth of terminal emulations (33) and file protocols (16) that Datastorm's newest Windows product supports.

Procomm Plus 3.0 is a group of integrated communications modules that interact and use a fairly consistent interface. In addition, the modules share major program components.

Procomm Plus supports three levels of access, a mail/bulletin board system, and remote operation. You can design screens and menus. Metakeys (macros) can transmit text, launch a script, or hook a C program to use the system variables.

There's a separate "window" for nearly every function—terminal, fax, Web browser, Internet mail, newsreader, and FTP client. (Except for the fax window, they're actually just different views that share a single window.) The Terminal window module provides terminal emulation and file transfer services, as well as direct serial connection via a shared asynchronous communication server or through a telnet connection. The Fax Status window launches automatically whenever you send or receive a fax. This window also monitors and reports the progress of all fax operations and all fax-related modem activity. Procomm Plus's Web Browser window handles any connection made with a WWW-class Connection Directory entry. The FTP Client window also provides some file management capabilities.

continued

Symantec's pcAnywhere32

Symantec, the 900-pound gorilla of the utility software industry, has produced the only true, completely 32-bit Windows 95 communications product in this report, pcAnywhere32. This program is also different from the others with its offering of remote control and direct cable connections. Its transfer speed is only so-so, and its interface, while among the easiest to use for file transfer, is not as convenient for accessing on-line services.

Two PCs running pcAnywhere32 can transfer files and synchronize directories with each other, control one PC from the other, establish a connection to and become a node on a network, and connect to on-line services and BBS sites.

pcAnywhere32's main window contains a pull-down menu bar, an action bar with eight buttons (six correspond to the program's primary functions), below the menu bar, and a main window area in the middle for creating connection items. The Quick Start button gives you access to wizards for setting up a gateway or host, for doing remote control or remote networking, and for calling an on-line service. When you click on an action button, the main window displays a wizard icon and any connection items previously created. A connection item represents a pcAnywhere32 file containing device information and security settings. The Add a Communications Item icon invokes a setup wizard that helps you create an item and configure it.

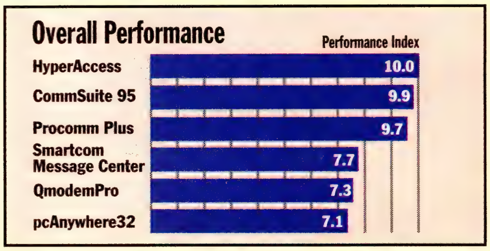
pcAnywhere32 includes several advanced features: SpeedSend transfers only the parts of a file that have changed; ColorScale improves screen-refresh transfer rates; an optimized desktop can disable host wallpaper, screen savers, and full window dragging; and remote security features can restrict drive access and file transfer rights, control hosts, audit calls, and encrypt data.

WIN 95 COMMUNICATIONS PRODUCTS RATINGS

BEST OVERALL

Delrina's CommSuite 95

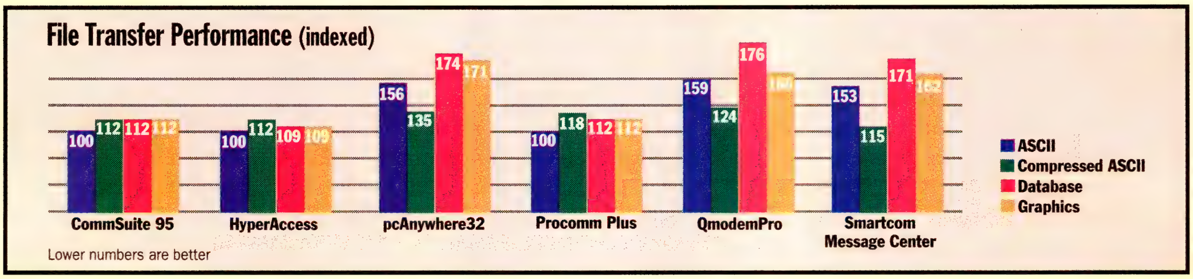
Excellent performance, rich versatility, and a well-designed, easy-to-use interface make this stand out from the competition.



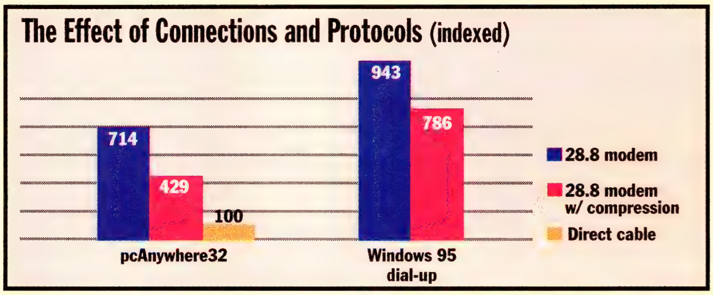
	PRICE	TECHNOLOGY	IMPLEMENTATION	PERFORMANCE	VERSATILITY	USABILITY	ERROR HANDLING	OVERALL RATING
CommSuite 95	$129	★★★★	★★★★	★★★★★	★★★★	★★★	★★★★	★★★★
Procomm Plus 3.0	$179	★★★	★★★	★★★★★	★★★	★★★★	★★★	★★★★
QmodemPro for Windows 95	$129	★★★	★★★	★★★	★★★	★★★	★★★	★★★
pcAnywhere32 for Windows 95	$149	★★★★	★★★	★★★	★★★	★★★	★★	★★★
HyperAccess 2.1A for Windows	$100	★★★	★★★	★★★★★	★★★	★★★	★★★	★★★
Hayes Smartcom Message Center	$99	★★★	★★★	★★★	★★	★★★	★★★	★★★

★★★★★ Outstanding ★★★★ Very Good ★★★ Good ★★ Fair ★ Poor

PERFORMANCE



The graphs above show the relative times each product takes to transfer four types of files: ASCII (289 KB), PKZIPped ASCII (128 KB), database (295 KB), and graphics (325 KB). For some programs, files precompressed with PKZIP take longer because their own built-in compression is more efficient than PKZIP. The chart at right shows relative ASCII file transmission speeds of one product over three different channels: 28.8-Kbps modem (with and without V.42bis compression) and direct cable. Compare this to the speed of Win 95's dial-up networking. pcAnywhere, like any of the products we tested, clearly does the job faster.



pcAnywhere32, in its native file transfer or remote control mode, presents the easiest and most convenient interface for swapping files. But it's not as easy to use for an on-line service.

Mustang's QmodemPro

If you need to connect to a really wide variety of systems and services, you should consider Mustang Software's QmodemPro for Windows 95, version 2.0. With its 35 terminal emulations and 16 file transfer protocols, it can talk to almost anything. Performance isn't up to that of the fastest comm programs, but QmodemPro is particularly well suited to accessing BBSes and on-line services.

QmodemPro can be used as a remote terminal or in host mode. The host software is a small-scale BBS program that enables a computer to receive incoming modem calls. Callers can read and post messages, upload and download files, and, if the system is so configured, take control of the host computer to run simple Windows commands.

When you open the program, you see the main menu, the status bar, and the configurable toolbar and macro bar. The terminal window displays on-line data and terminal-to-host dialog. You can have a macro bar for each phonebook entry.

The Dialing Directory button opens up a phonebook window that includes system names, telephone numbers, login names, passwords, and communication parameters. You can add notes and comments to each entry and mark and organize entries into groups for multiple dialing sessions. Each phonebook stores 1024 entries, and you can have an unlimited number of phonebook files. The simplest command-line switch starts up QmodemPro, specifies the phonebook file, and dials a specific entry. There's an automatic utility to convert phonebooks from various DOS and Windows communications programs.

continued

FEATURES

	COMMSUITE 95	SMARTCOM	HYPERACCESS	PCANYWHERE32	PROCOMM PLUS	QMODEMPRO
SYSTEM REQUIREMENTS						
Minimum/recommended RAM (in MB)	8 / 16	4 / 8	2 / 4	4 / 8	4 / 8	4 / 8
Minimal CPU platform	386	386	386	486SX	386	386
Disk space, minimum/full installation (in MB)	16 / 60	3 / 14	2 / 2	30 / 55	7 / 35	4 / 5
OTHER OS PLATFORMS						
Windows 3.x		✓	✓		✓	
Runs under Windows NT		16-bit	16-bit	✓	16-bit	
OS/2 version available			✓	✓	Included	
CONNECTIONS SUPPORTED						
Direct cable connection (LPT)	✓			✓		
PC Card	✓		✓			
Maximum number of COM ports	4	9	4	4	9	4
Windows NASI LAN connection (IPX/SPX)			✓		✓	
Internet Winsock (IPX/SPX, TCP/IP, NetBIOS/ NetBUI, and AppleTalk)	✓	✓	✓	✓	✓	✓
FILE TRANSFER FEATURES & PROTOCOLS						
Background file transfer	✓		✓	✓	✓	✓
Remote access to DOS/programs	✓		✓		✓	✓
Exit program without losing carrier	✓	✓	✓		✓	✓
Switch from data to voice and vice versa	✓		✓			✓
Off-line file compression	✓					
ASCII file-transfer protocol	✓		✓	✓	✓	✓
Proprietary HyperProtocol	✓		✓	✓		✓
Number of file transfer protocols	11	8	11	9	11	16
ADVANCED FEATURES, MULTITASKING						
TAPI/Unimodem support	✓			✓		✓
32-bit multithreaded design	✓			✓		✓
Built-in MAPI support	✓				Simple MAPI	✓
Use multiple COM ports simultaneously	✓		✓			✓
Number of terminal emulations	16	10	16	17	36	35
Telephone pad and dialer	✓				✓	
Answering machine, audio editor	✓	✓				
INTERNET CONNECTION SERVICES						
FTP file transfer	✓	✓	✓		✓	✓
Archie search, Gopher browse	✓		✓			
Finger, IRC	✓	✓	✓			
Web browser, newsreader, mail service	✓	✓	✓		✓	
SECURITY						
Password protection/encryption	✓	✓	✓	✓	✓	✓
Data encryption			Extra cost	✓		
Automatic callback security feature	✓		✓		✓	
Lock-out remote file transfer	✓	✓	✓		✓	✓

✓ = yes

QmodemPro has a built-in graphics viewer that allows zooming any graphics file up to 1600 percent, even while you're downloading it. You can view multiple pictures consecutively as they download.

The Script Language Interface for QmodemPro (SLIQ) compiler and debugger allows you to develop custom applications and log-on scripts. Built-in MAPI support lets you copy text and graphics from the terminal window to any MAPI-compliant application.

Hayes' Smartcom Message Center

Hayes designed the AT command set used to control virtually all modems. So it should be no surprise that Hayes' own software, the all-in-one Smartcom Message Center, supports most popular PC modems. But it's really designed to take advantage of special performance features in certain Hayes high-speed modems by relying on the implementation of a subset of those AT commands. Unfortunately, we didn't notice particularly good performance in our tests. Smartcom's overall speed was among the slowest of the group.

TECH FOCUS | **SECURITY**

The Remote Control Conundrum

Sometimes, something that's really good turns out to be really bad—or at least a decidedly mixed blessing. The remote control functionality included with some current communications software is like that.

With Windows 95, Microsoft added significant connectivity functionality to the operating system by rewriting the entire communications architecture. One function Microsoft didn't build in is remote control, leaving a big hole that third-party vendors are beginning to fill. Programs such as Symantec's pcAnywhere32 (reviewed here) as well as Traveling Software's LapLink for Windows 95 and Avalan Technology's Remotely Possible/32 now enable extensive remote control capability.

But is this a good thing? It's easy to be seduced by added functionality and forget that there are important security considerations. For example, my desktop PC is connected to the BYTE office LAN, and it also has a modem connected to it. At the present time, this LAN has no standard method for outside access (though that's in the works). But there's nothing to prevent me from setting my modem to auto-answer, activating remote-control software on the PC, and dialing up the modem from home with my notebook computer. If I do that, I get instant access to whatever resources, such as CD-ROM drives and network servers, are connected to that PC. That's a real convenience. But it's also a gaping security hole, especially if I leave that unattended PC logged into the network.

The remote control software that I've installed has password-based access control, but that's hardly the last word in security. And what if I forget or choose not to activate it? Most organizations won't want to risk exposing their data and their computing systems this way. Remote convenience or real control: That's the choice you have to make when you install a remote control product.

–Russell Kay

At the heart of the program is the Modem Manager module, which automates switching between different operating modes to handle incoming calls and outbound data and voice. The Message Center's main window is the starting point for program operations. Drop-down menus provide logical access to the product's features. Alternatively, 19 buttons provide quick access to most program activities. You can display as many or as few buttons as desired, and in any order. From either the menus or the buttons, you can manage phonebook, voice-mode, mailbox, modem, and answer-phone functions, as well as access the fax log and voice messages.

Fax on Demand keeps a log of all current faxes available for send-on-demand service. From this window, you can add, delete, modify position and title, and view and change graphics files.

Calling for a Choice

With Windows 95 and TAPI, data communications is finally being treated like any other office application. The six products we tested will all do the job for general communications, and, if your needs are normal, you won't go far wrong with any of them. But there wasn't much doubt as to which one we'd pick: Delrina's fast and versatile CommSuite 95. **B**

PRODUCT INFORMATION

CommSuite 95
$129
Delrina Group, Symantec Corp.
Toronto, ON, Canada
(800) 268-6082
(416) 446-8495
fax: (416) 443-4318
www.delrina.com
Circle 1079 on Inquiry Card.

HyperAccess
$100
Hilgraeve, Inc.
Monroe, MI
(800) 826-2760
(313) 243-0576
fax: (313) 243-0645
www.hilgraeve.com
Circle 1080 on Inquiry Card.

LapLink for Windows 95
$149
Traveling Software, Inc.
Bothell, WA
(800) 343-8080
(206) 483-8088
fax: (206) 485-6786
www.travsoft.com
Circle 1086 on Inquiry Card.

pcAnywhere32
$149
Symantec Corp.
Cupertino, CA
(800) 441-7234
(408) 253-9600
fax: (408) 253-3968
www.symantec.com
Circle 1081 on Inquiry Card.

Procomm Plus 3.0 for Windows
$179
Datastorm Technologies, Inc.
Columbia, MO
(314) 443-3282
fax: (314) 875-0595
Circle 1082 on Inquiry Card.

QmodemPro
$129
Mustang Software, Inc.
Bakersfield, CA
(800) 999-9619
(805) 873-2500
fax: (805) 873-2599
www.mustang.com
Circle 1083 on Inquiry Card.

Remotely Possible/32
$169
Avalan Technology, Inc.
Holliston, MA
(800) 441-2281
(508) 429-6482;
fax: (508) 429-3179
www.avalan.com/~avalan
Circle 1085 on Inquiry Card.

Smartcom Message Center
$99
Hayes Microcomputer Products, Inc.
Norcross, GA
(770) 441-1617
fax: (770) 449-0087
www.hayes.com
Circle 1084 on Inquiry Card.

Tadesse W. Giorgis has tested network and communication products at NSTL for over five years. He holds a Ph.D. from North Carolina State University. You can reach him at **tadesse@nstl.com** *or at* **editors@bix.com**.

Evaluations in this report represent the judgment of BYTE editors, based on extensive tests conducted by National Software Testing Laboratories, as documented in a recent issue of NSTL's monthly Software Digest. *To purchase a copy of the much longer, full report, with NSTL's own evaluations and data, contact NSTL at 625 Ridge Pike, Conshohocken, PA 19428; (610) 941-9600; fax (610) 941-9950; or editors@nstl.com. For a subscription, call (800) 257-9402. BYTE Magazine and NSTL are both operating units of The McGraw-Hill Companies.*

Jon Udell

Web Project

Lessons Learned

Advice distilled from a year of site-building experience and reader feedback.

A year ago, the BYTE Site served up its first document. By the time you read this, it will have delivered a million BYTE articles to a half-million visitors—an audience as large as our magazine's. Along the way, I've learned a lot about electronic publishing. And I've discovered how Internet-enabled applications can transform a Web site from a library of documents into a groupware platform that can energize the internal operations of a business as well as its relationships with partners and customers.

As a Web developer, I enjoy a unique advantage. The progress report that I file here each month is reviewed by a half-million computer professionals—you, the readers of BYTE. Your feedback has guided and enriched my ongoing R&D project. This month, I'll pass along some of the lessons I've learned.

An HTML Generator Keeps Paying Dividends

In last July's inaugural column, I described a technique for generating a Hypertext Markup Language (HTML) archive from a collection of well-structured ASCII texts. This approach continues to pay handsome dividends. Every time I enhance the HTML generator (a program written in EEL—the C-like extension language of Lugaru's Epsilon text editor), new features propagate instantly throughout the entire BYTE online archive. Some of the improvements added this way include:

- activation of URL-like character strings (automatic link creation)
- links to a unique-per-page feedback form
- links from thumbnails to full-sized images
- new image-containing documents that wrap titles and captions around bare GIFs
- rich table-of-contents pages that use indentation and data-type icons to display the structure of articles and the number and type of attachments

There's no end in sight. For example, a reader pointed out that pages with thumbnails would load faster if I added WIDTH and HEIGHT attributes to each thumbnail's IMG tag. And he showed me how to extract image dimensions from a GIF file: Bytes 7 and 8 are the width, 9 and 10 are the height. As soon as I write the EEL function to extract these values, tweak the function that emits the IMG tag for thumbnails, and rebuild the archive, the hundreds of pages containing thumbnails will improve.

Where There Is Structure, You Can Add Value

I was lucky to inherit the collection of well-structured text files on which my HTML generator operates. Another source of structure widely exploited on the Net is the RFC 822 format to which e-mail and Usenet messages conform. Searchable and navigable Web archives of listserv and Usenet discussions are among the most useful information resources on the Web.

Why do these resources exist? The reasons are so obvious that, ironically, we tend to forget them. Messages have a *regular* structure—From:, Subject:, Date:. And messages are *in ASCII*, therefore open to a wealth of programming tools.

Where There Isn't Structure, Create It

What happens when you exhaust all your legacy sources of regularly structured ASCII texts? You can create new ones! That's just what VPR, our Virtual Press Room, does (for details, see two previous columns: "Global Groupware" and "Perl Magic," November and December 1995 BYTE). Every day, vendors and public-relations professionals contribute a half-dozen documents to this database. The Web application that receives these documents converts them into HTML and creates a header (using HTML META tags) to store company, product, date, and other fielded data.

I'm continually finding new ways to exploit that header. During Fall Comdex, for example, I added a field to track press releases for products that vendors were nominating for the BYTE Best of Comdex awards. In the spring, I used a different field to track CeBIT award nominees. Then it dawned on me that the VPR database had acquired a Lotus Notes–like flexibility. An individual "record" in this database has no canonical shape. Some records include Comdex fields, some include CeBIT fields, many include neither. A Perl script scans the headers and builds the views we need.

Make the Most of Full-Text Search

In last September's "Web Search" column, I talked about two of the Web's freely available index-and-search tools: freeWAIS and SWISH. Both are still in play on the BYTE Site. At first I favored freeWAIS because it indexed and searched faster than SWISH. Now that the archive has grown to more than 5000 documents, I'm finding that freeWAIS's relevance-ranking feature gets in the way. If you're looking for *ISDN*, it thinks that a 50-word article containing that term is highly relevant because the term represents a relatively high proportion of the document's

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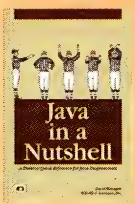
BOOKNOTE



Java in a Nutshell
($19.95)
by David Flanagan
O'Reilly and Associates
http://www.ora.com/

O'Reilly is famous for definitive technical references. Here's another reason why.

total content. So it prefers BYTE's What's New product announcements that mention ISDN to the meatier Features or Reviews that users more often want to find. To eliminate this bias, I'll probably convert our default search function from freeWAIS to SWISH.

Because Web search tools typically return document titles (that is, what's between <title> and </title> in the HTML header), you should think carefully about how you construct titles. I got ours partly right, but partly wrong. Here's what I got right: Every title that my HTML generator emits encodes three important pieces of information. The *issue* (for example, February 1995) tells you the age of the article; the *section* (such as Reviews, What's New) tells you the type of the article; the *title* tells you about the article. This combination of clues made the results of my first search implementations much more useful than would have been the case had I used HTML document titles alone. It also enabled the refinement I introduced a few months later. I tweaked the search scripts to pick out the issue names, sort on them, and group the search results in reverse-chronological order.

Here's what I got wrong: I forgot to include a fourth item, *BYTE Magazine*, in our titles. Why is that needed? On the BYTE Site, it isn't. Obviously, any search results gleaned from there refer to BYTE articles. But that's not so obvious when you view search results on Alta Vista or Open Text, where hits on the BYTE archive intermingle with hits from many other sources. The lesson here is subtle but profound. The Web punishes parochialism. You have to think globally. Your site isn't an island; it's part of a self-organizing federation of sites. Software components succeed by exposing clean interfaces to "the outside world." So, increasingly, will Web sites.

Defining and Using Field Indexes with freeWAIS-sf

1. Start with well-structured text.

```
<html><head>
<meta name=date content=96-01-23>
<meta name=comp content=Microsoft Corporation>
<meta name=prod content=Microsoft Internet Explorer>
<meta name=vnum content=900009>
<title>(VPR) Microsoft Announces Internet Explorer</title>
</head>
```

2. Define fields using regular expressions.

```
<layout>
<headline> /<meta name=vnum content=/ />/ 6 /<meta name=vnum
content=/
<headline> /<title>/ /<\/title>/ 300 /<title>/
<end>
<field> /<meta name=comp content=/
co “Company” stemming TEXT BOTH
<end> />/
<field> /<title]>/
ti “Title” stemming TEXT BOTH
<end> /<\/title]>/
```

3. Run the indexer.

```
% waisindex -d index -t fields /vpr/*.htm
```

4. Search the index.

```
% waissearch -d index co=Microsoft
  NumberOfRecordsReturned: 1
   1: Score:  997, lines:  34 '900009 (VPR) Microsoft Announces
Internet Explorer'
```

TOOLWATCH

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(510) 232-6800

Command-line access to the Win32 Open Database Connectivity (ODBC) subsystem. Here's one way to call database routines from Perl on Windows NT.

Use Full-Text Search with Fielded Search

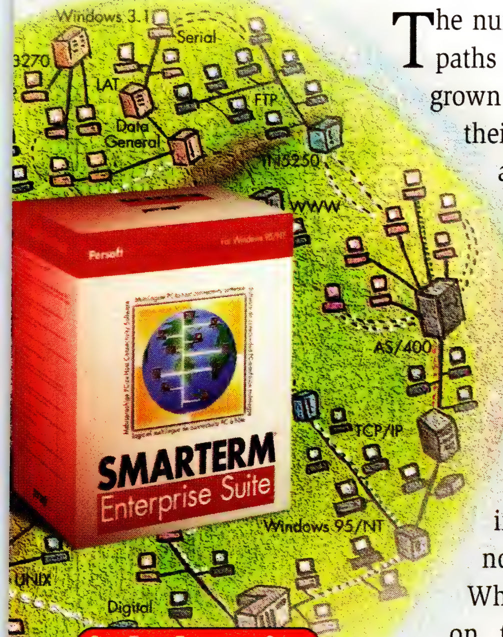
Responding to my "Web Search" column, Ulrich Pfeifer alerted me to a derivative of freeWAIS, called freeWAIS-sf, which he maintains at http://ls6-www.informatik.uni-dortmund.de/projects/freeWAIS-sf/. With freeWAIS-sf, you can index fields within documents. I've prototyped a version of VPR, for example, in which you can search for occurrences of *Borland* in the company field of each document—a much more precise search than for *Borland* anywhere in the text. Moreover, you can combine full-text and fielded search to answer questions, like "Which VPR documents from Borland, Microsoft, or Symantec mention Java compilers?"

I admit I've struggled a bit with freeWAIS-sf. I never was able to compile it successfully on our BSD/OS system. However, I did get it working on an SGI Indy. And there's a prebuilt binary available for the Linux system I just added to our server farm. The method for defining field indexes is obscure, but the idea behind the method is brilliant. You use regular expressions to describe regions of documents for which indexes should be built (see "Defining and Using Field Indexes with freeWAIS-sf"). This is an incredibly powerful technology. I hope to get a lot of mileage out of freeWAIS-sf. I'm also on the lookout for commercial products that retain its flexibility but are easier to use, such as the forthcoming Web-enabled version of InMagic's DB/TextWorks, called DB/Text WebServer (www.inmagic.com).

A Perl Apprenticeship

"There's more than one way to do it," Perl hackers say. Because Perl is such a forgiving language, I was able to build useful Common Gateway Interface (CGI)

Smart Routes to Connectivity



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Circle 99 on Inquiry Card.

Feedback from a Perl Master

Here's my orginal, clumsy version of vpr_GetMeta, a function to retrieve the contents of fields in the VPR document header:

```
sub GetMeta     {
 local($line,$meta) = @_;
 if ( index($line,$meta) ne -1 )         {
  @l = split(/$meta/);
 ($ret = $l[1]) =~ s/>//;
 chop $ret; }
else { $ret = ""; }
return $ret; }
$metadate = &GetMeta($_,"name=date content="); }
$metacomp = &GetMeta($_,"name=comp content="); }
$metaprod = &GetMeta($_,"name=prod content="); }
```

and here's Dov Grobgeld's elegant improvement:

```
foreach $type ('comp','date','prod') {
 ($meta{$type}) = /name=$type content=(.*)>/; }
```

"The regular expression is doing the whole job for you," says Grobgeld, "so there is no need to do a split nor use the index function."

applications almost immediately. But these early efforts were hardly models of Perl style. When I began to publish these scripts, Perl gurus kindly showed me how to improve them (see "Feedback from a Perl Master"). Here are a few observations of my own:

1) *Always localize variables.* Failure to do this led to the worst Perl bug I've inflicted on myself.

2) *Decompose regular expressions into named subexpressions.* The regular-expression syntax that Perl shares with many other Unix-derived tools is as subtle as it is powerful. Learn to decompose patterns into subparts. Test these individually, then assemble composite patterns incrementally, testing at each stage. Name the subparts so that the final composite expression makes sense.

Failure to properly decompose patterns leads to ugly results. Consider the pattern I showed in the "Web Search" column; it recognizes URL-like expressions in order to wrap HTML link syntax around them. It was easy, I thought. Look for a protocol prefix (http://, ftp://) followed by any string of characters not illegal in a URL. But that wasn't quite right. What happens when a URL appears at the end of a sentence? The final period, which matches as part of the pattern, invalidates the link. I'll spare you the contortions I went through and the silly solution I came up with. Suffice it to say that Earl Hood's MHonArc (ehood@convex.com), an e-mail-to-Web converter, showed me the answer. There should really be three subparts: a protocol prefix, a string of characters legal in a URL, and (crucially) a single URL-terminating character from a set similar to the second subpattern but lacking the period.

3) *Don't be afraid of Perl 5.* I was, at first. I found Perl 4's syntax daunting enough, and figured I should master it before tackling Perl 5's nested data structures and object orientation. That wasn't a bad idea in general, but it did lead to some unnecessary habits that I could have avoided. Most notably, I adopted a questionable technique for passing data among subroutines. The routine that parses VPR entries, for example, returns two lists. One list enumerates errors that the user must fix, the other warns of problems that the user may fix or ignore. But the routine couldn't return a list of these two lists. Why not? Perl flattens concatenated lists. Instead of a two-element list (an errors list and a warnings list), what came back was a single, undifferentiated list.

I solved the problem by injecting a sentinel character (I used the tilde) between the two lists. This approach, which I went on to use extensively, is workable but inelegant. You have to ensure that the sentinel never appears in any list element. And you need a different sentinel for each level of nesting. Far better to use Perl 5 to create *references* to lists (and also to associative arrays). That way, a function can return a true list of lists to a calling function, which can then unpack those lists in a standard way.

Avoid These Mistakes!

It's worth repeating: The Web punishes parochialism. Here are three mistakes that all resulted from my failure to grasp the big picture:

1) *Don't hard-code IP addresses.* The VPR archive lives on an auxiliary server. When I wrote the script that builds views of that archive, I hard-coded that server's address. Avoiding a DNS lookup can save a little time, and since I regenerate the views daily, switching addresses wouldn't be a problem, right? Wrong. Next week, I'm moving the server to our new T-1 link, where it will have a different address. And, yes, I can and will rebuild the views. But I can't rebuild the Alta Vista index that refers to VPR URLs at a soon-to-be-invalid address. Oops.

2) *Avoid NTisms.* Christopher Wanko wrote to alert me to the use of backslashes in the URLs I was creating on our search-results pages. Why the backslashes? On NT, freeWAIS returns NT-style path names, which I was foolishly pasting onto "http://www.byte.com" to form URLs. This generally worked, because most NT Web servers treat forward and backward slashes identically. Since my server could handle the mixed format, there wasn't a problem, right? Wrong. Chris was accessing our site from behind a Unix proxy server that barfed when it saw the hybrid URL. Oops.

3) *Quote all URLs.* You're supposed to do this: <a href="/file.htm">. Instead, I got into the habit of doing this: <a href=/file.htm>. None of the browsers I've tried cares one way or another about the latter quoteless style, so it's no problem, right? Wrong. A reader wrote to tell me that his company's firewall couldn't handle the quoteless URLs. Oops again. Don't lose sight of the big picture.

As the BYTE Site continues to evolve in its second year, I'll build on the lessons I learned in the first year, make new, and perhaps even more-enlightening, mistakes in the future, and continue to learn together with BYTE readers. **B**

Jon Udell **(judell@bix.com)** *is BYTE's executive editor for new media.*

BYTE special report

NT EVERYWHERE

Microsoft is using new technologies and marketing muscle to push NT 4.0. How well will it serve desktops, large-scale networks, and Web servers?

4.0 Isn't for Everyone

Microsoft put a new face on 4.0 and may have improved performance. But has the OS become less stable?

Page 121

NetWare: Fight or Switch?

If you decide to switch from NetWare, are NT's migration tools solid enough for a smooth transition?

Page 127

NT and the Net

Microsoft's NT-based Internet applications are free. Here's what you can expect for your money.

Page 133

NT Server's Growing Pains

Before you trust a large network to NT Server, know how it compares to NetWare in scalability.

Page 137

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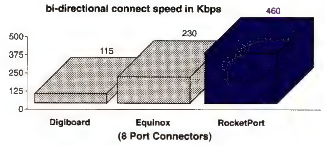

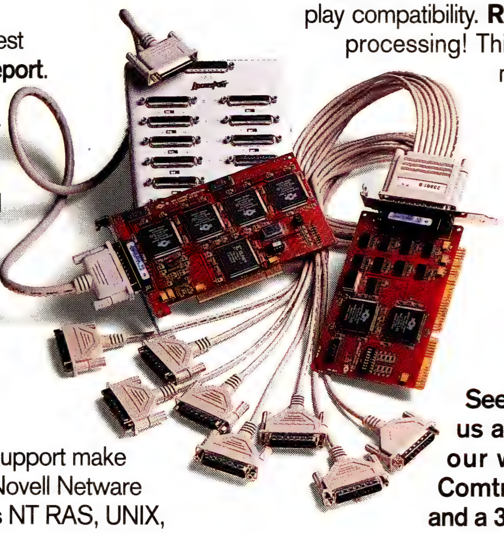

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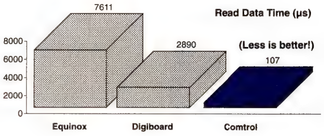

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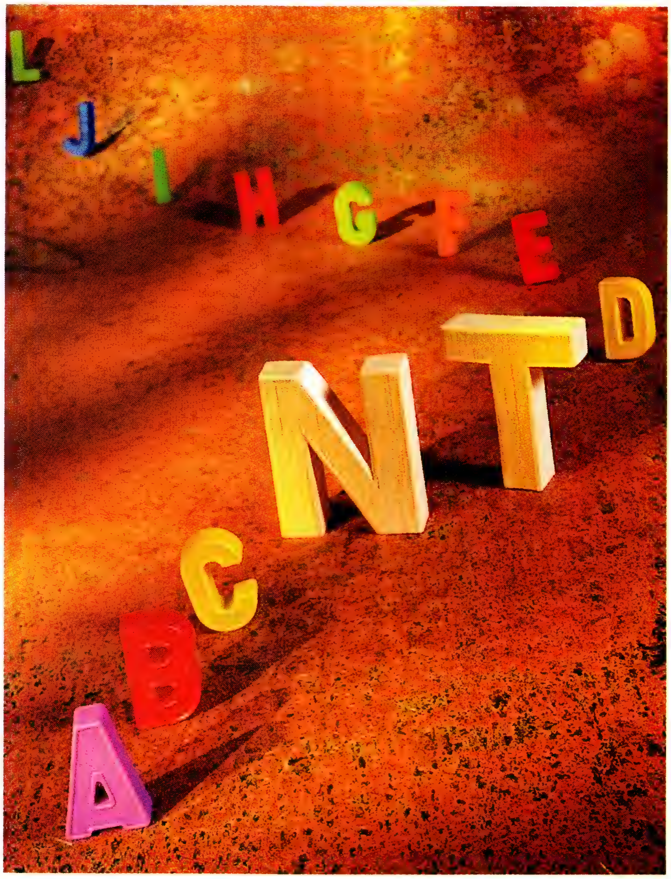
SPECIAL REPORT

4.0 Isn't for Everyone

Has Microsoft traded stability for performance in the latest NT release?

By David S. Linthicum

If you're not already a Windows shop, NT is no more or less important than any other operating system that's vying for your heart, mind, and corporate servers. But if you are running Windows 95, you probably feel yourself racing toward judgment day like a skydiver with a busted parachute. Sooner or later, you'll switch to NT.



In the meantime, there will be upgrades to 95 and to NT itself, and all the while you'll ask yourself, "Are there enough performance benefits to go to NT?" "Can we handle all the additional resource requirements for NT?" "Is it better to wait or take the leap now?"

Microsoft's slated release this summer of NT 4.0 raises these questions anew, not only for Windows 95 users but also for those who must decide whether to upgrade from NT 3.51 or make a more fundamental switch from Unix. But in its wisdom, or in spite of it, Microsoft hasn't delivered a new version of NT that makes the upgrade decision a slam dunk.

NT 4.0 is better than 3.51. It's faster, it's more agnostic about networks, and if you want to set up a Web server, you can't beat the price: All the capabilities to do this now come standard. So what's not to like? Most of all, NT's designers made a pact with the performance devil. To squeak out speed, they went the kernel-mode route—which Novell was roundly criticized for with an analogous move in NetWare 4.x—and that potentially opens up NT to system crashes.

At the moment, the NT migration question is cloudy. If you're contemplating the change, here's what's good and bad with NT 4.0, along with advice for deciding what's best for you.

Built for Speed

For this article, we were able to review NT 4.0 beta 1 (build number 1234). Although clearly still a work in progress, this iteration shows how Microsoft is advancing the existing NT architecture, which merges the attributes of layered and microkernel operating systems.

The NT Executive, a group of several subsystems and OS services, runs in kernel mode (see "NT's New Architecture" on page 122). This placement means that basic OS functions, such as first-level interrupt handling, deferred procedure calls, thread scheduling, and synchronization primitives, communicate directly with the hardware for faster performance. Also within the Executive is the hardware abstraction layer (HAL), which provides software abstraction for such items as clocks, cache and memory controls, peripheral devices, and symmetric multiprocessing functions. This abstraction layer enables Windows NT to support a wide range of hardware designs within a microprocessor family.

What makes 4.0 significantly different than earlier NT iterations is Microsoft's decision to relocate within NT's kernel mode the graphical device interface (GDI), giving it Ring 0 status. (Ring 0 is one of four protection modes in Intel's CPU designs.) This gives GDI functions—all the commands that write to the screen—the highest priority possible. No overhead means faster performance. But it also means no protection for the OS in the event, for example, that a third-party graphics driver is plagued with problem code. In NT 3.51, the GDI didn't communicate directly with the hardware, so a problem with a graphics driver would have crippled the user interface but would not have brought the entire system down. That potential exists now with 4.0.

The Ring 0 vulnerability is also found in NetWare 4.x. (IBM hasn't taken this path with OS/2.) The issue is critical for NT because NT is more likely to run cross-platform tools, such as emulators, that write directly to the GDI rather than to an API. Clearly Microsoft is heading down the kernel-mode road to enhance performance. Our tests running standard business applications and

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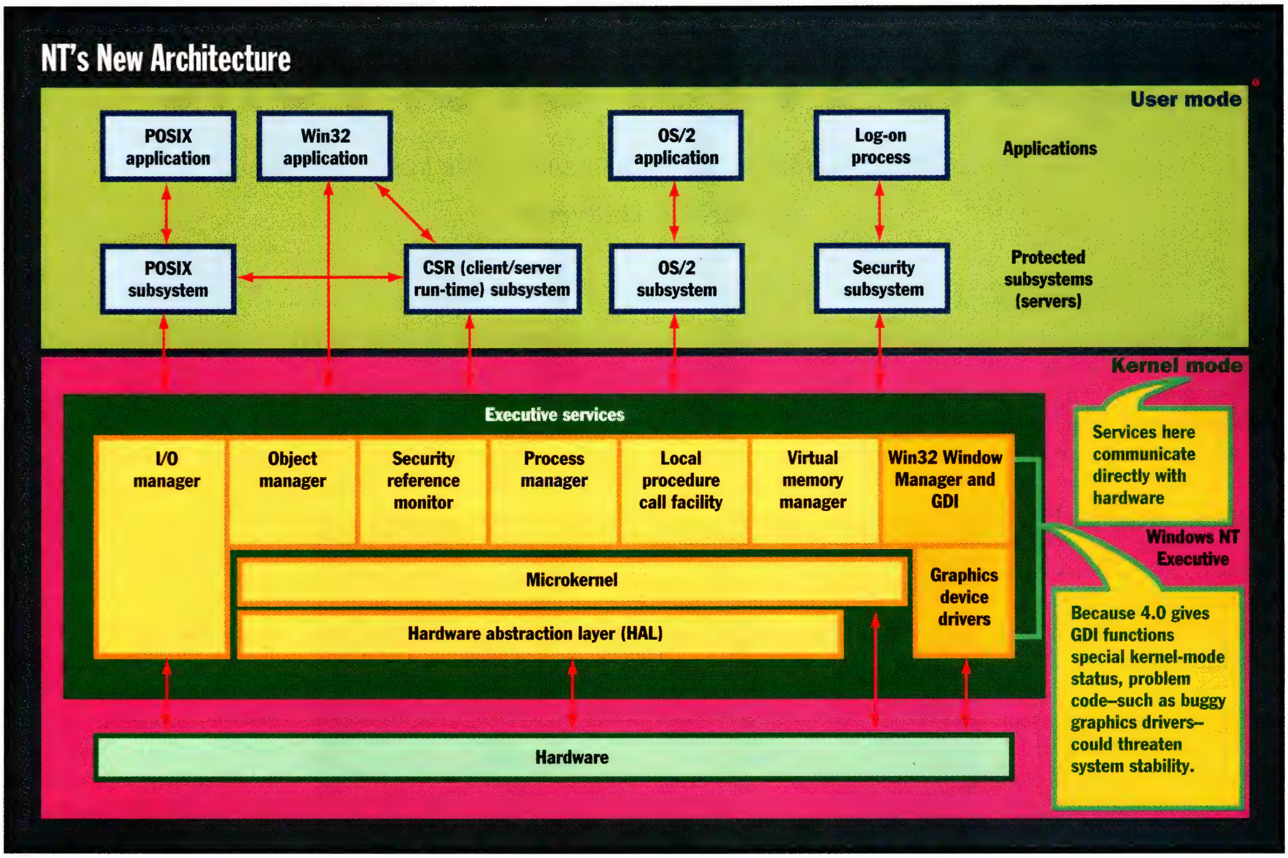

NT's New Architecture

Services here communicate directly with hardware

Because 4.0 gives GDI functions special kernel-mode status, problem code–such as buggy graphics drivers–could threaten system stability.

To boost graphics performance in NT 4.0, Microsoft made the controversial decision to move the Graphical Device Interface (GDI) from user mode to kernel mode.

graphics-intensive games showed 4.0 to be noticeably faster than NT 3.51. However, the kernel-mode approach may cause stability problems as driver authors write code that burrows deeper into the OS to extract faster performance in their applications. Thus, Microsoft may be trading stability for performance.

Our tests with the beta software did not uncover a smoking gun: None of the crashes we experienced could be attributed directly to the architectural change. But the decision to make this change—and its departure from traditional design practices—troubles us. Drivers are volatile, and now they could be a weak link in NT's stability.

Stability is more of an issue with NT Server than with NT Workstation because a single server crash will also bring down all the clients attached to it. That's not to say that workstations are immune to potential problems. If a client goes down, the IS support staff will have to track down the cause, which will be difficult since a frozen workstation will not be able to run diagnostics software.

Microsoft says it works with hardware manufacturers to develop reliable drivers and that the change doesn't affect the stability of the system. All drivers shipped with the OS, the company adds, are submitted to the same testing as other Executive components. We won't know how significant the kernel-mode issue is until we have final 4.0 code and monitor how well the OS runs in real-world situations.

This potential vulnerability is all the more troubling considering the steps Microsoft has taken in other areas to avoid NT system crashes. NT 4.0 remains more stable than Windows 95 thanks to Microsoft's use of virtual machines, which are secure areas in the OS where an application can execute as if it were using its own processor and memory space. This means that unruly applications won't bring the entire system down. Instead, only the virtual machine will die, leaving the OS in a stable state. NT runs MS-DOS applications in their own virtual machine, and you can run Win16-based applications in a virtual machine as an option. NT 4.0 also uses virtual machines for multitasking and multithreading of Win32 applications.

New and Improved Server

The NT Server and Workstation modules emanate from the core architecture. Both have seen a number of changes in 4.0. Each module now provides all the major network protocol stacks (including NetBEUI, IPX/SPX-compatible, and TCP/IP), as well as easy connections to NetWare, NFS, Vines, and existing NT servers. NT 4.0's updated version of Microsoft's Client and Gateway Services for NetWare now supports NetWare Directory Service (NDS).

One of the most appealing additions to NT Server is the integrated Internet Information Server, or IIS (for more details, see "NT and the 'Net" on page 127). With IIS, you can turn NT Server into a fully functional Web server (that can also perform its other duties). Microsoft wants you to look to NT, and not Unix, for your Web server needs. What chance does NT have to compete? Compared to most flavors of Unix, NT is easier to use, it

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Other new Internet features include a Domain Naming System (DNS) name service. This is significant because it provides a distributed database of host information for local networks and the Internet. With DNS, you can resolve computer-name-to-IP-address mapping queries. You also can configure the DNS name service for use with Microsoft's Windows Internet Naming Service (WINS), which dynamically allocates IP addresses for host name resolution. The combination of WINS and DNS provides the Dynamic DNS, which resolves the upper layers of the domain name and passes the final resolution to WINS. This is transparent to the NT Server client.

Server 4.0 also supports multiprotocol routing to help network administrators connect LANs or connect LANs to WANs without a costly dedicated router. For instance, administrators can set up LAN-to-LAN routing support for IP and IPX by connecting both a TCP/IP and a NetWare LAN. You can also configure NT Server to act like a BOOTP/DHCP Relay Agent that allows a computer to transmit BOOTP/DHCP messages across an IP LAN. However, using NT Server to connect LANs and WANs requires at least two network adapters (one for each segment) inside your server hardware.

New administration tools in NT Server can run remotely on Windows 95 clients. In addition, NT Server provides remote boot service for Win 95 clients. This is especially helpful if you're working in a secure environment with Windows 95 diskless workstations. NT Server also lets you create your own special groups by arranging resources, such as printers, for easy reference and browsing. You create these groups using the WINS Manager tool, or through the LMHOSTS file. However, each group is limited to only 25 members.

Anyone involved in the federal market will be happy to know that Server 4.0 continues its POSIX tradition. Microsoft plans to build on the base OS services to support upcoming POSIX standards as they evolve.

Better Interfaces

Both the Server and the Workstation editions of NT 4.0 present a Windows 95 look-alike interface. If you've run Windows 95, you've already seen many of the new interface features in NT 4.0: the Windows Explorer, the Internet Explorer browser, and WordPad. Clearly Windows NT 4.0 is Windows 95 reincarnated for the power user. NT functions the same as Windows 95, with the same hierarchical drag-and-select menu structure and the ability to examine the file system. The new interface is especially adept at opening programs (you can launch applications using Macintosh-like point-and-shoot icons), finding documents, and using system tools such as Explorer.

NT 4.0 and Windows 95 Compared

NT 4.0 Advantages	**Benefit**
Virtual machines	Makes NT more stable
Internet Information Server	Free Web-server capabilities
Distributed COM	Handles distributed objects
RISC support	For single- and multiprocessor systems
Windows 95 Advantages	**Benefit**
Portions written in Intel Assembler code	Faster speed on Intel-based PCs
Plug and Play	Integrates portables with docking stations

Also new to the NT interface is the Microsoft Windows Messaging Subsystem, which lets you send and receive e-mail, including files created in other applications. Already message-enabled are most of the 32-bit applications that run on Windows NT, including Microsoft Word and PowerPoint and Borland Paradox. Unfortunately, NT 4.0 does not support Multipurpose Internet Mail Extensions (MIME) mappings to filename extensions. And messages containing attachments are sent in MIME format as an application/octet-stream, not as a MIME type. Therefore, you may want to consider another fully MIME-enabled e-mail system if file attachments are common in your organization.

A new Hardware Profiles feature (familiar to Windows 95 users) lets you create a list of hardware configurations to meet specific requirements. This is most useful for people who run NT on a portable computer with a docking station. When you dock the portable, NT prompts you to select a hardware configuration (using variables like network interface card, printer, and monitor). When you remove the portable from the docking station, NT returns to the previous system configuration.

Preliminary Tests

Our beta of 4.0 was noticeably faster than NT 3.51, depending on what type of application we ran. We compared performance of 4.0 versus 3.51 by using a 133-MHz Pentium machine with 32 MB of RAM. We ran Win32 and Win16 applications, which we automated with macros or application programs. All applications worked without any compatibility problems. In general, we found the performance of Win32-based applications like the Microsoft Office Suite was excellent under NT 4.0, but Win16-based applications (e.g., Excel 4.0) lagged behind. DOS applications performed well, and NT 4.0 adapted to the most unruly graphical DOS applications, such as arcade-type games. We did crash the system once, but the result was a dead MS-DOS session and not a dead OS. However, when we ran Adobe Photoshop, some image windows did not repaint properly. And Lotus Approach crashed when we selected Send Mail from the File menu. (Note that none of these problems relate to the kernel-mode issue.)

Will performance be even faster once Microsoft finishes the final version of 4.0? That depends. Developers will surely optimize the code, which will make it faster. However, our beta version still did not include Distributed COM (Common Object Model), which has replaced Network OLE as the name for Microsoft's distributed object technology. DCOM lets communications take place among objects without any object needing to know the physical location of any other object. We were unable to judge how any

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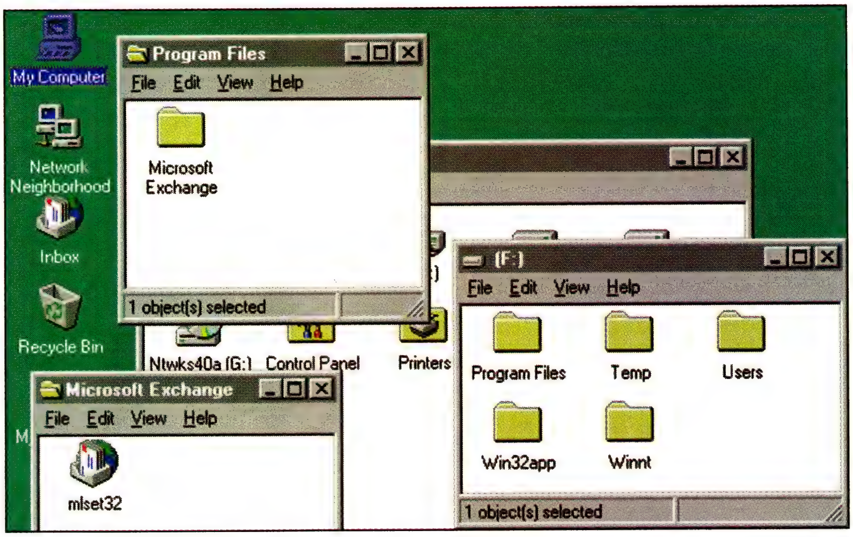
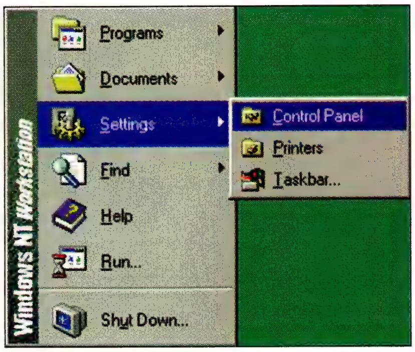
overhead from DCOM might affect performance (and we still remember how performance in Windows 95 went to hell in a hand basket when Microsoft added the OLE subsystem). Until we test with that component, we have only half the performance story of NT 4.0. (Microsoft planned to include DCOM in the beta 2 version that was scheduled to be released after we filed this story.)





Look familiar? Windows NT 4.0 adopts the interface design of WIndows 95.

The Bottom Line

So, if Windows NT 4.0 looks a lot like Windows 95 and offers many of the same look-and-feel and OS features, what are the reasons to include 4.0 in your migration plans? That depends on the platform you're currently using.

If you're now running Windows 95, NT 4.0 may be more stable, thanks to its virtual-machine approach. (Kernel mode is an open question, however.) Another of NT's key differences from Windows 95 is NT's support for multiple platforms and for symmetrical multiprocessing. NT can provide this support because Microsoft wrote it in portable C, while developers wrote huge portions of Windows 95 in processor-dependent Intel Assembler (however, Windows 95 provides better performance on Intel-based computers with fewer resources).

NT adheres to the Advanced RISC Computing (ARC) open specification for RISC-based systems in both single and multiprocessing configurations. These RISC platforms include the PowerPC, MIPS R4xx00, and Digital Equipment Alpha. In the past, NT didn't support x86 software on these systems, which was limiting since only the major software vendors bother to port to non-x86 hardware. The good news is that NT 4.0 provides a 486 emulator for non-Intel platforms. The 486 emulator is another application that can convert the nonnative x86-dependent calls into calls the native processors understand. Emulation overhead does levy a performance hit, however.

In the short term, the changes to NT Workstation probably won't produce a wave of converts: Windows 95 will continue to rule the desktop. The absence of Plug and Play in NT 4.0 will discourage people who rely on this Win 95 capability for portables with docking stations.

The bottom line for Windows 95 users is this: If you're committed to Windows applications and need to run them in a crash-protected or cross-platform environment, it may be time to move to NT. If you're a mobile worker who relies on Plug and Play capabilities, you should stay with Windows 95 for now.

If you're already running NT 3.51, the leap to 4.0 will seem as wide as the gap Windows 3.1 users crossed when they moved to Windows 95. The speed improvements we see in the final version of 4.0 will go a long way to helping you make your decision. Also, if distributed objects within your enterprise will become the foundation for your applications, 4.0 grows in importance.

At first, the new UI may be appealing, but you should also consider the impact the learning curve will have on your organization. If NT 3.51 currently serves you well, the interface alone isn't enough to switch to NT 4.0.

If you're a Unix or other non-Windows shop, NT 4.0 can give you the advantages of a huge base of business applications that may be more extensive and less expensive than what you're using. If you've already considered 3.51 and decided against the switch, the new UI and Distributed COM, if Microsoft pulls it off in this revision, could be new inducements to go NT. Also, NT 4.0's support for multiple hardware platforms means you can upgrade to faster processors to meet new requirements.

No matter which group you're in, you should set up a test-bed of representative hardware and software for your organization and run extensive compatibility tests using 4.0 before you make any decisions. Your mix of resources is unique, and you should find compatibility and performance problems before you decide to change to any new OS.

The last issue you need to consider is Cairo. We expect DCOM to be part of the Cairo OS, as well as an object-oriented file store and Plug and Play (see "OO Meets OS," November '95 BYTE). At that point, NT will have morphed object-oriented technology, the interface and mobile-computing benefits of Windows 95, and the already solid server features of NT. It's a formidable package—on paper. But even if Cairo stays on track, it's a distant target. In the meantime, NT 4.0 offers an intriguing choice. B

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SPECIAL REPORT

NetWare: Fight or Switch?

Microsoft fields new technologies—and migration tools—in the battle against NetWare.

By Steve Gillmor

Sacrilege! Are you truly considering choosing Microsoft's Windows NT over Novell's NetWare? You're not alone. Microsoft's Trojan horse strategy continues to gain ground in the battle with Novell. And although Microsoft used "Start Me Up" as the theme song for Windows 95, "Time Is on My Side" might be more appropriate for Windows NT.

Slowly but surely, Microsoft is fighting a technology and marketing war with Novell to convince people to move from NetWare to NT and to help companies make the big switch, with several migration-specific tools—and some free components—thrown in to sweeten the deal. The tough part for end users isn't just in measuring NT against NetWare point for point in technology (see the text box "How to Decide if You Need NetWare or NT" on page 128). You also need to consider how to switch from NetWare if and when you decide that's the right move (see the table "Six Steps from NetWare to NT" on page 130). Here's some help on both scores.

ILLUSTRATION: EARL RIPLING © 1996

War of the Web

As this article went to press, NT was in a transition. The initial beta release of NT 4.0 offers a glimpse of what's to come in the latest version (see "4.0 Isn't for Everyone" on page 121), which has a vague release date of "this summer."

Beta or not, we see that one of the hottest spots in the marketing war between Novell and Microsoft is over their dueling Web sites. Microsoft is adding a host of enhancements and new technologies to NT 4.0 to leverage the Web and its global TCP/IP-based WAN.

One enhancement plays into intranet and corporate-downsizing trends, which are accelerating the growth of mobile and work-at-home communications. As bandwidth becomes the gold standard of the nineties, Microsoft has extended NT 4.0's Remote Access Service (RAS) to leverage ISDN and secure network access by way of the Internet. NT 4.0's multilink PPP support for bandwidth aggregation allows bonding of both B channels of an ISDN Basic Rate Interface (BRI) line to double the speed of a dedicated private connection. You can continue to add ISDN lines for further improvements or employ multiple analog lines in instances where ISDN is not available.

The new Point-to-Point Tunneling Protocol (PPTP) integrates with RAS to enable virtual private networks. Developed by Ascend Communications, ECI-Telematics, Microsoft, 3Com/Primary Access, and U.S. Robotics, the PPTP protocol encapsulates and encrypts packets for transmission over the Internet. NT servers can now use a dedicated Internet connection through RAS at one end, while Win 95 and NT 4.0 workstation clients dial up their local Internet service provider's (ISP) point of presence (POP).

Not only does this reduce or eliminate long-distance charges, but companies can now leverage an ISP's modem and ISDN Internet-adapter pool. If your ISP installs PPTP extensions, there is no need for you to install a PPTP driver on the client. U.S. Robotics is writing the NT Server 4.0 driver for Microsoft; it and other hardware manufacturers plan to embed the technology in remote-access communications devices used by ISPs.

Microsoft dropped the other shoe in the Web war by integrating its Internet Information Server (IIS) software into NT 4.0. IIS inherits NT's security, performance monitoring, and SNMP management capabilities, providing both Common Gateway Interface (CGI) and its own Internet Server API (ISAPI) to extend programmability (see "NT and the Net" on page 133). BackOffice owners of SQL Server and other ODBC-compliant (Open Database Connectivity) data sources can employ the bundled Internet Database Connector for template-driven catalog publishing.

continued

On the client side, Microsoft's Internet Explorer browser will add Visual Basic Scripting tools in the 3.0 release. With Visual Basic for Applications soon to span the Microsoft Office suite, the Remote Automation technology introduced in Visual Basic 4.0 will surface in NT 4.0 Server and Workstation. Once dubbed Network OLE, Distributed COM (DCOM) exploits OLE Control (OCX, now called ActiveX) component tools for building distributed applications.

Visual Basic also extends Microsoft Exchange Server's applications development environment. Exchange in turn adds X.500-based messaging-specific attributes to NT Server Directory Service, letting administrators automate the migration of existing users and configure new-user and mail accounts in one operation.

Now that TCP/IP is NT's new protocol of choice, Microsoft is adopting another child of the Internet. The Domain Naming System (DNS) that Unix machines on the Internet popularized will integrate with NT's existing Universal Naming Convention (UNC) and Windows Internet Naming Service (WINS).

WINS (in conjunction with DHCP) already provides dynamic host name resolution for Microsoft networks. In a mixed network, hosts can now employ a single name service based on DNS's Internet standard. Using DNS in this way is significant because it addresses NT's technological Achilles' heel.

If this interoperability helps glue together the vast majority of directories, Microsoft may have found a way to keep Novell Directory Service (NDS) a niche player. That would be important, because NDS—a global directory service that stores information in a hierarchical tree structure that any authorized user or administrator can view in a single glance—is superior to NT's flat-file directory-service technology.

With NT Server 4.0, Microsoft will upgrade the existing Client and Gateway Services for NetWare to support NDS navigation, authentication, printing, and log-in scripts. NT users will have to wait for Cairo (due no earlier than 1997) to match or surpass NDS. In the meantime, Microsoft seems to be trying to shift the focus away from directory services—and toward incorporating Web tools into NT—for companies that are trying to decide whether to switch from NetWare to NT.

How to Decide if You Need NetWare or NT

50 to 150 clients: You need file and print services with messaging and limited applications services–it's as easy to maintain applications on individual clients as it is to use an applications server.

Choice: NetWare, for lower cost of existing hardware and leveraging of existing software.

As your organization grows–**150 to 500 clients**–central management from an applications server becomes critical for software updates and maintenance. Messaging evolves to some limited groupware tools for scheduling and remote communications.

Choice: NetWare for its larger installed base of management tools, but NT for its applications server, RAS communications, and groupware/BackOffice integration.

As the number of self-contained sites grows–**500 to 5000 clients**–directory services become mission-critical, offering global management of users, resources, and servers. The increased impact of the Internet and TCP/IP shifts issues from LAN to WAN; single log-on and security become paramount.

Choice: NetWare and NDS as current best-of-breed, but NT's IIS and BackOffice services integration are increasingly the wave of the future.

With an **object-based network**, all elements of the global network are available to both navigation and programmable control. All 32-bit clients can access and manage any resource. Tools based on the Visual Basic/Java model are resident from front end to back end and from client to server.

Choice: Windows NT (Cairo) or some other dominant OS that might appear.

Appealing APIs

Besides nailing down the Internet, Microsoft is also stealing a page from its own playbook with the Open Directory Services Interface (ODSI). Like its siblings ODBC and MAPI, ODSI is a set of APIs that gives developers access to multiple directory-service providers. Developers can write OLE Automation controllers with Visual Basic, Perl, Rexx, and other tools to perform common directory tasks, such as adding new users, managing printers, and locating resources across multiple directory services.

Although Novell has not yet signed on to write a service provider (i.e., a vendor-specific driver-like layer) for NDS, Microsoft will include one when ODSI arrives (sometime after NT 4.0 ships). ODBC rolled out in much the same fashion, with native optimized drivers following once the standard gained wide acceptance. Similarly, rival IBM/Lotus has adopted MAPI for use in its Notes groupware product.

Microsoft's ability to anticipate and absorb the rapid growth of client/server and intranet/Internet technologies means NT is a difficult target to hit. But Novell has made the best of a bad situation in recent months. It dropped its SuperNOS strategy and applications suite, endorsed the use of Visual Basic and other rapid development tools for its new Net2000 API, and made tentative moves toward porting NDS to NT. NetWare also continues to hold its ground with large-scale networks (see "NT Server Growing Pains" on page 137).

But Novell may feel an uncomfortable kinship with OS/2 fans. NDS may be a superior directory management tool in the same way that OS/2's multitasking and object-oriented interface exceeds Win 95's in the minds of many people. Yet the public and applications vendors alike have voted their preferences by continuing to move toward the Microsoft bandwagon. The ultimate Microsoft migration strategy is to make it good enough for now and then keep making it better.

NT Bait

NT may be gaining ground on NetWare, but how easy is it to make the transition from NetWare 3.x or 4.x to NT? Not surprisingly, Microsoft is trying to be as helpful as it can be. It built migration tools into

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—*Ray Duncan*

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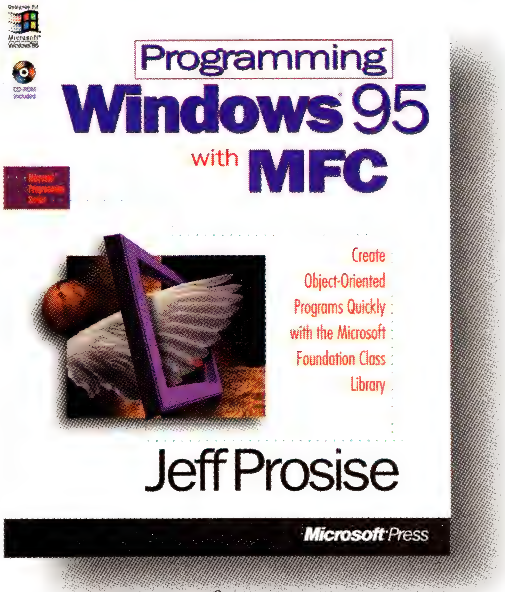
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Six Steps from NetWare to NT

	Action	Method	Results
Step 1	Add NT applications server to NetWare LAN.	NT Server with NWLink IPX/SPX-compatible protocol.	• NetWare clients can access NT Server applications. • Retain and continue to access NetWare servers.
Step 2	Give NT clients a gateway to NetWare LAN.	Gateway service for NetWare (GSNW).	• NT clients can access NetWare servers. • All clients can use TCP/IP for dial-in and Internet access.
Step 3	Central administration of NetWare and NT accounts.	Directory Service Manager for NetWare (DSMN).	• Ability to manage user and group accounts centrally from NT Server directory services.
Step 4	Give NetWare clients access to NT Server file and print services.	File and Print Services for NetWare (FPNW).	• Access to shared files and printers on NT Server.
Step 5	Migrate users to NT Server.	• Migration Tool for NetWare 1.1. • Remove NetWare server. • Rename NT Server to name of NetWare server.	• Migrate log-in scripts, files, and directories and permissions to NT Server. • NetWare server hardware becomes available.
Step 6	Move completely to NT network.	• Transition to TCP/IP with Microsoft clients. • Add Internet Information Server (IIS) for Internet/intranet publishing.	All-NT network.

NT right from its earliest incarnation.

The first tool to appear with NT 3.1 was NWLink, an IPX/SPX-compatible transport stack that gave NetWare-compatible clients access to NT applications services. Not only did Microsoft recommend using NWLink as the default protocol (no surprise there), but NetWare users with DOS and Windows 3.x machines could save valuable conventional memory by loading just one protocol stack.

Microsoft added two more lures to NT 3.5: the Gateway Service for NetWare (GSNW) and the Migration Tool for NetWare. GSNW lets an NT server connect to a NetWare server as a NetWare client, allowing NT clients to access NetWare resources as though they were NT resources. Here the NT workstation can leverage a mixed NT/NetWare network without loading two sets of client services.

The downside, however, is that the pass-through connection adds overhead and funnels everything through a single NetWare user account; you'll need to use NT's bundled Client Services for NetWare to log on individually. Still, NT's built-in RAS gives you a powerful tool for dialing up a NetWare LAN while still retaining your favorite protocol (which is likely to be TCP/IP) on the desktop.

The Migration Tool for NetWare uses NWLink and GSNW to access NetWare servers. It automates the transfer of NetWare user and group accounts, files and directories, and security and permissions to NT Server. A few things got lost in the shuffle, including NetWare's User Disk Volume Restrictions and passwords. As a result, you can set all passwords to a default name, no name, or the user name, force users to change their passwords on log-in, and create a mapping file to customize account information.

The first release did not support the migration of log-in scripts, but you could still perform a trial migration to sort out duplicate user- and group-name conflicts. If you wanted to maintain both NetWare and NT servers for the time being, you would simply perform the migration and leave your NetWare servers intact. In this way, Microsoft's solution meant you could add an NT applications server automatically without having to hand-key all the account information.

With NT 3.51, Microsoft provided the File and Print Services for NetWare (FPNW) add-on utility. FPNW makes an NT server look just like a NetWare 3.12–compatible file and print server to existing NetWare client software. Also, the enhanced Migration Tool 1.1 supports the transfer of user and system log-in scripts.

Installing the FPNW service adds extensions to the Server, User, and File Managers to manage NetWare volumes, files, and user connections. On the NetWare client, end users can exploit Microsoft versions of utilities (e.g., Attach, Login, Logout, Slist, Map, Capture, Endcap, and Setpass) just as they normally do. NetWare loadable modules (NLMs) don't work, but you can use NWLink to access a SQL Server database or other application service directly from your existing NetWare client.

If the goal is a phased migration, FPNW enables you to transition gradually without affecting the NetWare user base. During the migration, shared directories can be available to NetWare and NT clients alike; users can move transparently between the two environments, either one at a time or globally. Once you've used the Migration Tool, you can replace the original NetWare server with an NT server. You just rename either the NT server or the FPNW service with the name of the NetWare server and then disconnect the NetWare machine.

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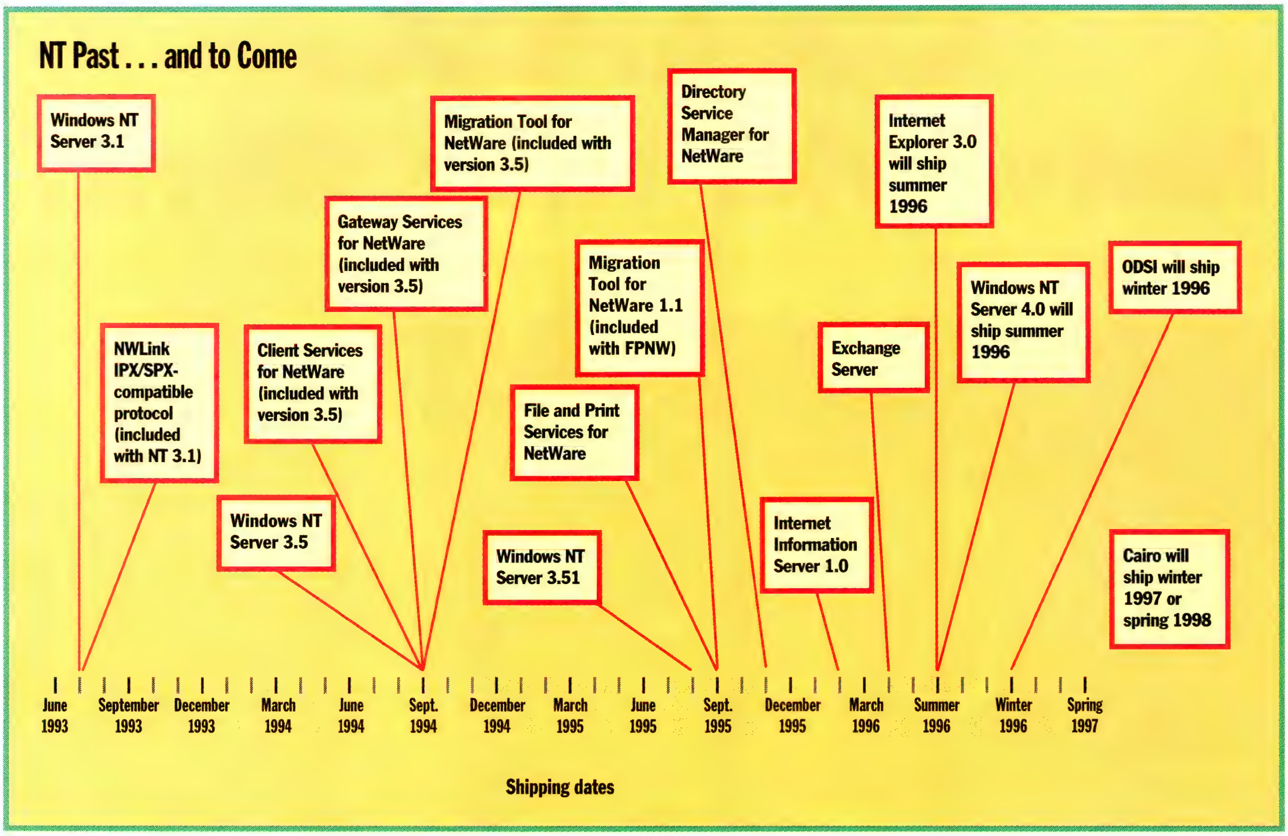

NT Past . . . and to Come

NetWare clients can take advantage of NT's Directory Service and the trusted domain technology to get a single network log-on across the enterprise, something not possible with the NetWare 3.x servers most vulnerable to migration. What FPNW does not allow is centralized management of user accounts, passwords, and security information, which in the NetWare 3.x world happens on a server-by-server basis.

At Your (Directory) Service

Microsoft's domino strategy continues with a second add-on utility, called the Directory Service Manager for NetWare (DSMN), which gives administrators the driver's seat in both directions on a mixed NT and NetWare 2.x/3.x network. DSMN extends the Migration Tool's functionality, copying NetWare user and group account information to NT Server Directory Services and then automatically propagating any subsequent changes back to the NetWare server contingent.

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www.microsoft.com

Novell, Inc.
Orem, UT
(800) 453-1267
(801) 222-6000
www.novell.com

After selecting a strategy for password re-creation, you can select which group accounts you want to propagate back to the NetWare server. Next, you run trial synchronizations and check log files for errors—the software prompts you to use the BindFix utility to back up the NetWare Bindery. Once synchronization occurs, administrators can add a new user and make account changes from a single location. Users can log on to any NT or NetWare server with the same name and password.

DSMN hit the wall at NetWare 4.x and NDS. Although the utility can synchronize NetWare 4.x servers through bindery-emulation mode, it does not support NDS itself. As mentioned earlier, the forthcoming NT Server 4.0 will offer upgraded Client and Gateway Services for NetWare. Also, NT Server 4.0's adoption of the Win 95 user interface will provide more intuitive and centralized tools for both FPNW and DSMN. Nevertheless, NT's flat-file directory service technology will need more than a face-lift to compete with NDS's functionality.

NT offers tools to monitor and manage network operations. From the User Manager screen, you can keep track of user information. Port Status provides the vital signs of external connections. Event Viewer offers detailed looks at System Log events. Remote Access has its own area for monitoring the reach-out-and-touch crowd you support. An extensive Network Settings screen permits adding, removing, changing, and configuring network adapters and software.

Novell still has numbers on its side; the installed base of NetWare users remains large enough to fill NT's creators with envy. But in an industry where the only sure things are death, taxes, and constant change, loyalty doesn't count for much. Microsoft is working to give you reasons to switch to NT and to make sure a lack of migration tools doesn't derail any transition plans. NT 4.0 won't make NetWare passé, but it will keep NT's momentum rolling. B

Steve Gillmor (Charleston, SC) is senior vice president of Barkley Communications Co. and director of Southern Digital, Inc. He consults on Lotus Notes, Visual Basic, Windows NT, and digital-media issues for corporations. You can reach him by sending e-mail to **72662 .3701@compuserve.com.**

NT and the Net

Do you get only what you pay for with Microsoft's free NT-based Internet applications?

By Tom Yager

What's the biggest growth area in network services? The Internet, which is no surprise. IS people are feeling the pressure to make more impressive Web services available to both employees and to people outside the company.

While Unix has so far dominated Web development, Microsoft is now laying claim to providing all the software needed to build and deliver complex applications over the Internet, starting with Windows NT. Microsoft also offers the Web server (Internet Information Server, or IIS), the database server (SQL Server), the development tools (Visual Basic and Visual C++), and even the glue (Open Database Connectivity [ODBC], Internet Server API [ISAPI], Windows Sockets, and OLE).

Therefore, you pay for NT, the development tools, and, optionally, the database server. However, Microsoft will give away its Web server, its Internet Explorer client, and all the software and documentation needed to crank out custom Internet applications. This not only helps you maximize your limited resources, but the Internet components let technology-shy organizations experiment with distributed applications.

Fine: A single-source vendor is good, and free is even better. But what about technology? Traditionally, Unix has ruled in hosting networked applications, and with good reason. It's mature and highly scalable. Also, all the protocols Internet users take for granted first dawned within Unix. Why develop under NT?

Tables Are Turning

That the Unix world remains splintered and discouraging for cross-platform development is old news. While Unix vendors fiddle, Microsoft is craftily infiltrating Unix strongholds with stable, multiplatform, natively graphical NT. Two years ago, Unix might have been the automatic choice for anyone deploying Internet services. Now the tables are turning in NT's favor.

The differences between NT and Unix are common knowledge (see "Which Side Are You On?," May BYTE). What's not as well understood, however, is that NT is, on paper, the perfect Internet application server: It's lean, it's relatively scalable (see " NT Server's Growing Pains " on page 137), it's affordable, it has a complete array of standard network services, and its standard file system supports such essentials as striping and mirroring.

It also installs fast, boots and shuts down in a hurry, and has strong security. Unix still can't approach NT's ease of installation and use. Unix does offer an administration advantage: Telnet lets you remotely manage Unix machines over the Internet from any terminal, as long as you have the proper access rights. NT still falls short in remote administration.

The reasons to implement under Unix instead of NT boil down to one: If you have a significant investment in Unix hardware or applications, stick with it. Yet, even if Unix is what you have, that does not mean that you have to specify Unix forever. NT plays nicely with Unix workstations and servers in the same enterprise. Admittedly, what NT still won't give you are NFS (which you can add) and X Window System. Still, if you are creating Internet applications for use outside your enterprise, these shortcomings hardly matter.

Web Server, Cheap

Microsoft's Web server, IIS, is downloadable for free from Microsoft's Web site (www.microsoft.com). This is no crippled application or limited-time free trial. Microsoft is giving away a fully functional commercial-quality Web server. It's no surprise that IIS works hand in glove with NT and is an integral part of Microsoft's Internet applications-development strategy. IIS is a server that answers HTTP, gopher, and FTP requests from clients.

continued

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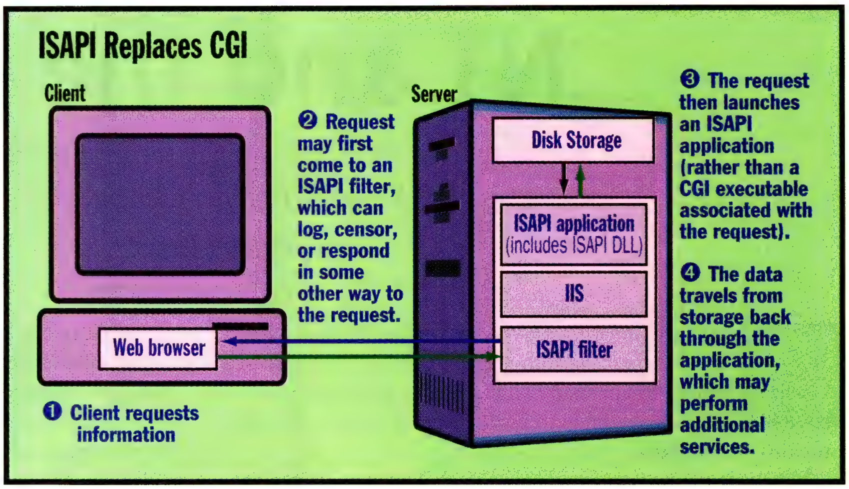
ISAPI Replaces CGI
Client
Server
Web browser
Disk Storage
ISAPI application (includes ISAPI DLL)
IIS
ISAPI filter
❶ Client requests information
❷ Request may first come to an ISAPI filter, which can log, censor, or respond in some other way to the request.
❸ The request then launches an ISAPI application (rather than a CGI executable associated with the request).
❹ The data travels from storage back through the application, which may perform additional services.

ISAPI sets up communications among the client, server, and DLLs.

IIS takes full advantage of NT's built-in security, even supporting encrypted password exchange for those clients (such as—no coincidence—Microsoft's own Internet Explorer) that support it.

This server is no slouch on other features. Multihoming lets a machine running IIS appear to the Internet as several distinct Web sites. Virtual directories hide your system's true directory structure from browsers, improving security and making configuration changes easier to endure. Remote administration lets you manage all the servers in your enterprise from one console.

Microsoft would deserve credit just for building these laudable features into IIS 1.0, but the company's vision extends beyond basic services. A key feature for applications development is that IIS is remarkably extensible. A skilled developer can build custom Internet applications that use IIS to deliver data in a number of ways.

IIS isn't the only Internet server for NT. Among Microsoft's competitors is Netscape, whose cross-platform Netscape Enterprise Server 2.0 runs on both NT and a variety of Unix variants.

NT vs. CGI

Web authors well understand the Common Gateway Interface (CGI) method of extending Web-server functionality. You simply include a uniform resource locator (URL) in your document that points to an executable file on a server. The server will then launch that program, with any required arguments coming from a search request, a form, or the URL itself. The Web server sets environment variables (e.g., information about the client and the connection) before launching the CGI program. A CGI program outputs its results, usually in Hypertext Markup Language (HTML) format.

Because most Web servers have run on Unix systems, CGI programs are normally Unix shell scripts or Perl scripts. NT offers both those language choices, and you can use them with IIS the same way you would if you were running under Unix. The exception, of course, is that many Unix external commands are not standard under NT. The MKS Toolkit from Mortice Kern Systems fixes that and provides a true Korn shell for CGI programming.

Advancing past mere Unix emulation, NT lets you reach beyond basic scripting languages for your CGI executable files. Visual Basic 4.0 runs under NT and is an excellent, more powerful alternative to shell and Perl scripts. It's still an interpreted language, so don't expect light-speed computations.

On the plus side, you can use ODBC and MAPI to bulk up your Internet applications with database access and multiprotocol e-mail. You could use the multimedia features so that the system makes sounds when certain conditions exist or present formatted text and graphics in response to Web users' actions.

Microsoft is making noise now about a leaner—and less capable—BASIC called VBScript. Like Sun's JavaScript, you could embed VBScript in your Web pages to create active documents. Text-entry validation is one example of a function VBScript could handle. The server wouldn't even see the document until all the required fields were filled and they passed the VBScripted validation tests. You could also embed OLE objects in Web documents that, when activated, would launch VBScript applications on the client side.

There's one serious drawback to using interpreted server-side scripts: Each call to a CGI executable file incurs heavy overhead. The server has to load a sizable interpreter that must load, parse, and run the script file. All this takes time and resources, and it's repeated for every page that includes CGI references.

DLLs Aren't Dull

You can partially solve performance problems by using Visual C++ or another tool that produces stand-alone executable files. These files do not need a run-time interpreter, so they load much faster. Of course, they *run* faster than interpreted code. However, it's still an imperfect solution: The server must reload that executable file every time a browser activates its CGI link. Microsoft's IIS includes a more efficient mechanism: DLLs.

Microsoft ingeniously allows authors to specify DLLs as CGI executable files. NT will first check to see if the requested DLL is now loaded (presumably by another request for a similar link). If it is already loaded, there's no overhead. IIS just calls the DLL. However, if NT has to load the DLL, it loads into the same process as the Web server itself. IIS can also preload commonly used DLLs and automatically unload them after a specified time.

Because a DLL has no concept of standard input and output (the mechanism through which IIS communicates with other CGI programs), Microsoft uses an API for passing arguments and data between the server and its helper DLL. Part of the broader ISAPI, this procedure sets up communications among client, server, and DLL.

The server calls the entry point `GetExtensionVersion` when the DLL loads and then calls `HttpExtensionProc` for each client request. `ReadClient`, `WriteClient`, and `GetServerVariable` are among the functions that let the DLL communicate with the remote client and IIS. It's a blissfully simple API. Any programmer used to writing C or C++ code won't see a problem with building server extensions as DLLs.

IIS also includes an ISAPI DLL that provides access to databases. You can embed queries and other manipulations of ODBC-compatible databases in your HTML documents. If you run BackOffice

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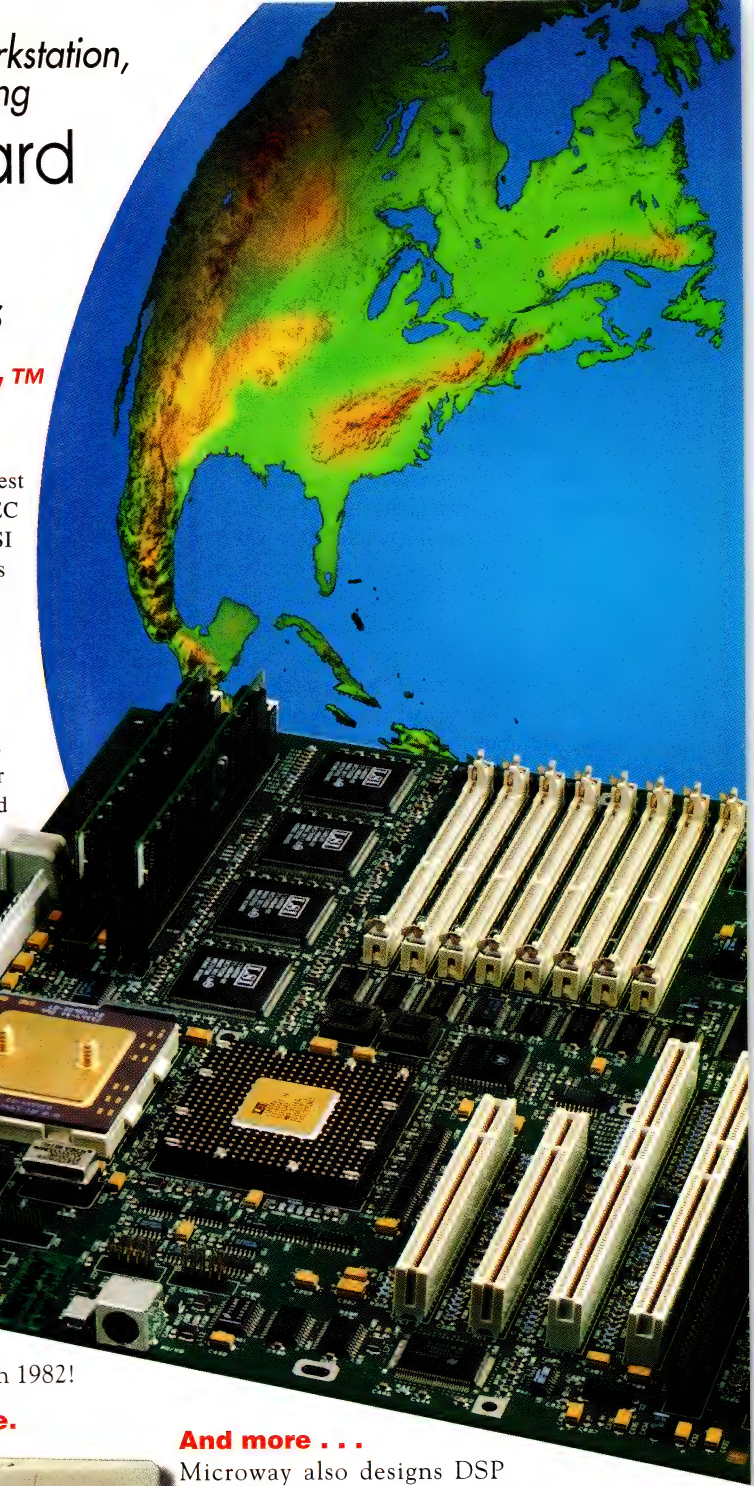

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Memory, Cache, PCI . . .

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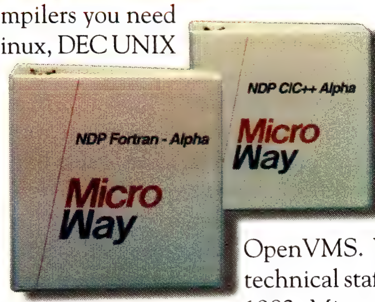
Microway adds the operating systems and compilers you need to put the 21164 to work. These include NT, Linux, DEC UNIX and OpenVMS, which now run thousands of applications including AutoCad, Excel and Word. The Screamer and Microway's NDP Fortran, C | C++ and Pascal compilers are available to both OEMs and end users.



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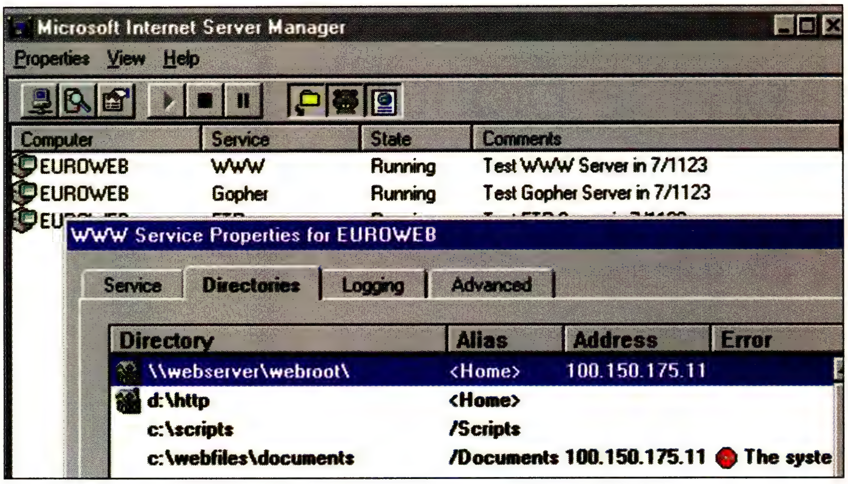
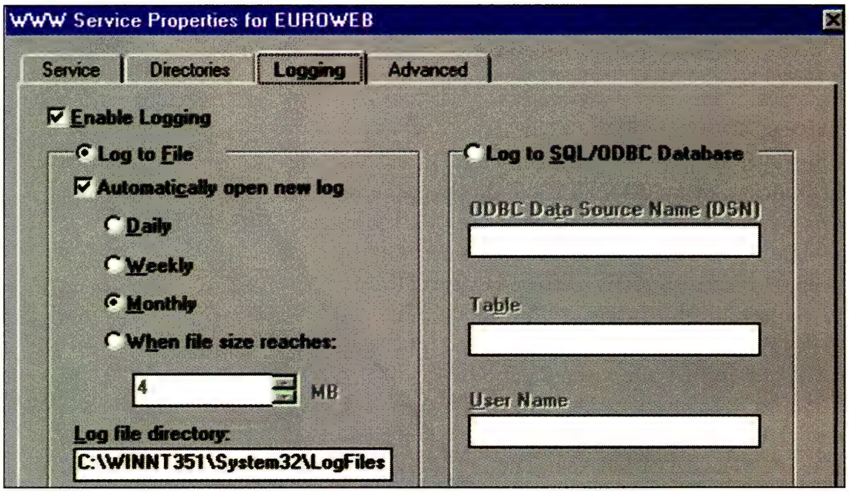

Microsoft Internet Server Manager
Properties
View
Help
WWW Service Properties for EUROWEB
Service
Directories
Logging
Advanced

Computer	Service	State	Comments
EUROWEB	WWW	Running	Test WWW Server in 7/1123
EUROWEB	Gopher	Running	Test Gopher Server in 7/1123

Directory	Alias	Address	Error
\\webserver\webroot\	<Home>	100.150.175.11	
d:\http	<Home>		
c:\scripts	/Scripts		
c:\webfiles\documents	/Documents	100.150.175.11	The syste

In IIS's virtual-directory facility, long paths collapse, and hidden drive letters make storage configuration changes easier to manage.



☑ Enable Logging

● Log to File

☑ Automatically open new log

○ Daily

○ Weekly

● Monthly

○ When file size reaches:

4 MB

Log file directory:
C:\WINNT351\System32\LogFiles

○ Log to SQL/ODBC Database

ODBC Data Source Name (DSN)

Table

User Name

You can send IIS log data to an ordinary file or store it in a special table in a SQL or compatible database.

on your IIS system, BackOffice's SQL Server component provides efficient and capable database services to IIS.

Pure, Filtered HTTP

ISAPI DLLs aren't just for replacing CGI programs. You can also create filters using ISAPI. You have the power to intercept every client request, analyze them, and do something clever with them. Maybe you want to create a customized log program that keeps detailed records of the transactions you care about. You might use an ISAPI filter to watch for hackers who attempt to coax your server into sending files outside your HTML source tree. With matching plug-ins on the client side, you could implement encryption, authentication, or secure traffic. One use might be to prevent underage users from accessing material intended for adults.

You can install as many ISAPI filters as you like by making entries in the registry. Each filter has its own priority level and event mask. The priority determines the execution order for multiple filters. Each filter's event mask tells IIS which client events should pass to that filter. Client requests trigger some events. For example, `SF_NOTIFY_READ_RAW_DATA` lets the filter look at each byte of data before it goes to the client.

Your filter can analyze the data and pass it unmodified. Or, it can modify the data to, say, remove profanities and pointers to GIF images. Your filter can also tell the server this particular event should fail, in which case the client gets an error message from the server.

Your filter can also find out when a session starts and ends. You can choose notification at the start of secure sessions, nonsecure sessions, or both. If you want to watch the URLs being accessed at your site, the server can feed you the client's URL requests before it maps them to physical locations. With this, you can intercept URLs, even new types, and process them in your DLL.

The combination of the usual CGI and filter DLLs makes it possible to add almost anything to IIS. The ISAPI specification is simple, with easy-to-follow policies for entry points and data structures. You're protected from having to understand anything about sockets and ports. As you write your applications, you can be oblivious to the fact that the user is probably hundreds of miles away.

Sure, you still have the limitation that your responses need to be in HTML format, but more advanced browsers like Microsoft's Internet Explorer and Netscape's Navigator support plug-ins. With custom code on the client side, and Microsoft's ability to support OLE and ActiveX objects in HTML documents, you're able to create complex Internet applications. Those applications can speak whatever language they like to each other, using IIS as a conduit.

Before you conclude that Microsoft is giving away the store, remember its motives: Microsoft is betting that you'll want to buy BackOffice, Visual C++, and Visual Basic to tie all the goodies together. Keep an eye on the Microsoft Web site to see what new browser plug-ins, ISAPI DLLs, and other useful tidbits magically appear. At this writing, Microsoft announced VBScript and its intent to give it away (with a compiler) on its Web site. VBScript has not, however, appeared yet. Until it does, you still have plenty of options for deploying custom Internet applications under NT. B

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NT Server's Growing Pains

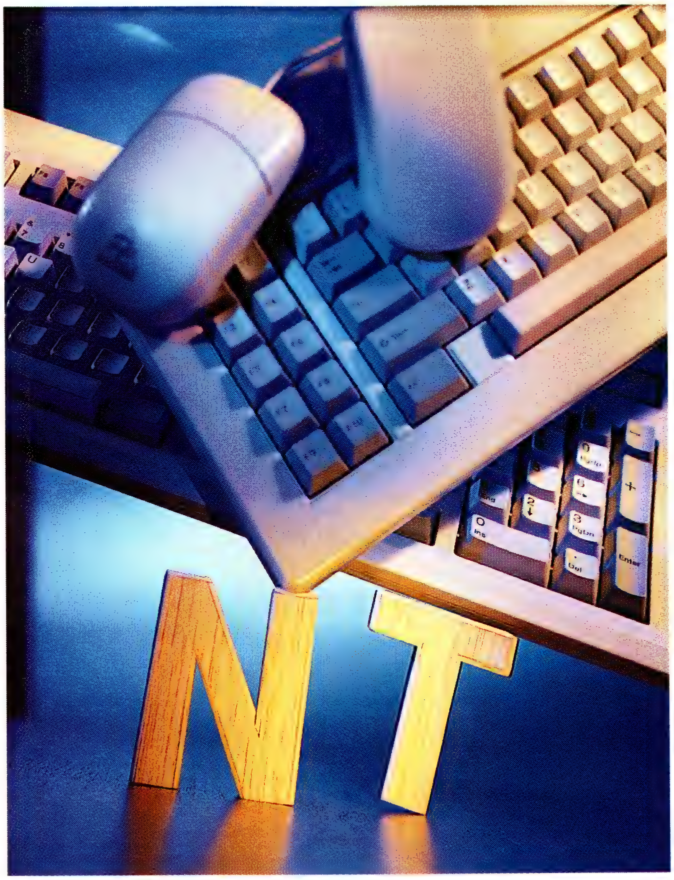
Before you trust a large network to NT Server, know its scalability shortcomings—and Microsoft's intentions to address them.

By Barry Nance

You wouldn't try to cut down an oak tree with a bread knife. And you wouldn't tow a trailer with a Vespa. Sometimes size matters—with your network, for example. A group of 10 PCs can use a peer-to-peer LAN product such as IBM's OS/2 Warp Connect, Microsoft's Windows 95, or Artisoft's LANtastic. A larger network of 100 PCs might share one or two file servers running Novell's NetWare, Microsoft's NT Server, IBM's LAN Server, or another network OS (NOS).

However, networking 1000, 10,000, or even 100,000 computers is a completely different story. Suddenly, scalability isn't only whether the NOS can run on different platforms or use symmetric multiprocessing (SMP) computers. You now have to think of scalability from organizational, environmental, and managerial viewpoints—in terms of the whole network.

Windows NT Server and Warp Server are coming on strong in the 100-plus-node network arena, displacing such products as Banyan's Vines, NetWare. But how does it fare when it's confronted with a 500-server network? The newest version, NT Server 4.0, offers expanded networking services (see "4.0's Not for Everyone" on page 121).



However, concerns about the underlying architecture still raise questions about NT Server's scalability in the minds of some network managers. Can you manage large networks easily? Can users log in and use resources transparently? How does it handle clients that are running Windows, Mac OS, Unix, or OS/2 Warp?

The NT Server architecture scales better than its predecessor LAN Manager did, but it comes up short when compared with NetWare. NT is a good application server, but its shortfalls—primarily in the areas of directory services, dynamic IP assignments, network management, and network administration—make it less scalable than its competition.

Directory services and domains are two different ways to deal with the problem of finding a needle in a large haystack. NetWare 4's NetWare Directory Service (NDS) does it by handing you the needle when you ask for it. NT Server uses domains, which basically tell you to look in a smaller haystack. Clearly, NT has much growing to do in this area (for more details, see the text box "StreetTalk Access for Windows NT" on page 140).

In Microsoft LAN Manager, a domain was an independent, nonhierarchical database of account information; it didn't have a mechanism to tie multiple, independent domain databases together. In an attempt to overcome this design limitation, Windows NT introduced trust relationships between domains. In a trust relationship, a domain grants access to users if they have rights in a trusted domain. Trust relationships provide users a single log-in to their home domain and potential access to resources in other domains that trust the user's home domain.

Management of relationships can be difficult. A trust relationship doesn't grant users access to resources in trusting domains. Instead, it lets an administrator in the trusted domain grant access rights to resources in the trusting domain. Only after administrators establish a trust relationship between domains can users access resources in the trusting domain.

Worse, the number of two-way trust relationships grows geometrically. It's N times (N–1), where N is the number of domains. Six domains require 30 trust relationships (see the figure "Tangled Domain Trusts" on page 138), 50 domains require 2450 trust relationships, and 100 domains require 9900. That's a lot of relationships to set up and administer.

In contrast, a directory service gives users, administrators, and their computers transparent access to all network resources. The CCITT has defined a standard for directory services—X.500.

continued

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It says a directory service should provide network name functions that map all network resources and that give them unique identities for easy reference.

The name functions should supply location-independent access to network resources, offer extensible attribute information (i.e., detail about a resource that its name alone can't convey), and allow searching for network resources by attribute, such as a printer's type or location. NT doesn't offer X.500-compliant directory services.

NT replicates domain information across multiple servers to provide some degree of fault tolerance. Every Windows NT server that has a copy of the domain is known as a Domain Controller. The two types are Primary Domain Controller (PDC) and Backup Domain Controller (BDC). Each domain must have at least one PDC and can have multiple BDCs. Each Windows NT server may participate as a Domain Controller in a single domain.

The PDC synchronizes across the domain, periodically communicating with the BDCs to distribute account information and ensure the integrity of the Domain Database. The PDC contacts the BDCs at definable intervals and sends mirrors of recent updates. While users can employ either the PDC or a BDC for login authentication, all changes to the domain occur on the PDC (see the figure "NT Server Administration" on page 139). If the PDC is down or unreachable, administrators cannot update domain information until they manually intervene to promote a BDC to become the PDC. This makes the PDC a single point of failure.

The replicated directory services database provided by NDS does not have this limitation. Administrators can partition and replicate the NDS database among many NetWare file servers, and can update NDS on any server that contains a read/write copy of the database. As long as a server that contains a replica of the partition is available, all administrative functions are possible, including adding or deleting users, groups, profiles, file servers, printers, print servers, message servers, and organizational units.

Because NDS replication does not depend on a single, primary database, it has no single point of failure (see the figure "NDS Server Administration" on page 139). Any server that contains either the master or a read/write replica of the NDS database communicates with all other

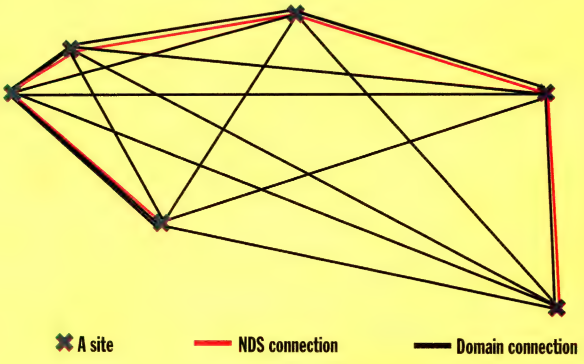
Head-to-Head: NT Server Domain and NetWare NDS Attributes

Function	NT Server	NetWare NDS
Can new objects be added to the database (i.e., is the database extensible)?	No	Yes
Number of administrative object types	Five	Unlimited
Administration limited to a single server?	Yes, the Primary Domain Controller (PDC)	No (1)
Effort to remove account database?	Reinstall OS	Point-and-click
Effort to move server to different group?	Reinstall OS	Point-and-click
Merge database option (domain or NDS tree)?	No	Yes
Single point of failure	Yes (PDC)	No
Database structure	Flat	Hierarchical
X.500-compliant	No	Yes
Permit both centralized and decentralized administration?	Depends on domain structure	Yes
Maximum objects allowed?	Recommend 15,000 per domain	Unlimited (2)

(1) Administration can occur on any server that contains an NDS database.
(2) Sixteen million per NDS server, but hierarchical database may be distributed across multiple servers.

Tangled Domain Trusts

With NDS, each site can access network resources at any other site, which means a six-site network needs only six connections.



The NT domain model requires trust relationships between each site for total access to resources. A six-site network needs 30 connections.

NetWare Directory Service (NDS) replicates itself across the enterprise. NT's domains require geometrical trust relationships.

servers with similar replicas. Any server can exchange NDS information with any other server that shares a common replica. If a server is unavailable for synchronization, updates will continue among the remaining servers, permitting full NDS administration of the NDS tree, regardless of the state of any single server.

Here's another limitation to NT's domains: Moving an NT server from one domain to another requires you to reinstall the OS. To move a NetWare server to a different branch of the directory tree, you merely indicate your change in Novell's NWAdmin software—a point-and-click operation.

Similarly, you move resources (e.g., users and printers) in NT by deleting the entry in one domain and adding the entry in the other domain. NWAdmin makes such chores a drag-and-drop operation. Since NDS groups can include user objects from any portion of the NDS tree, a transferred user retains all the prior group memberships and immediately inherits all rights granted to his or her new home on the NDS tree.

Using IP

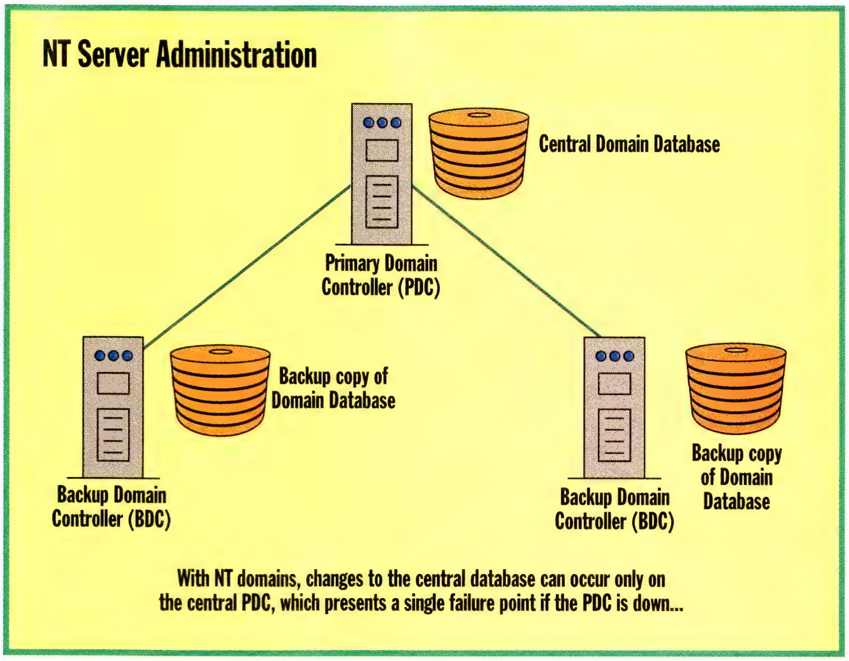
Everyone wants to get on the Internet. For an administrator, that can mean assigning each desktop system its own IP address and then tracking them. Intelligent NOSes take care of the assignment and tracking for you. In this respect, NT is better than NetWare but not as intelligent as OS/2 Warp Server.

The technology for automatic IP address assignment and tracking is Dynamic IP, which is composed of DHCP and Dynamic Domain Naming System (DDNS). DHCP and DDNS are complementary open networking standards developed by the Internet Engineering Task Force (IETF). Each protocol implements half of the TCP/IP "plug-and-go" network solution. DHCP centralizes and automates the configuration of IP hosts, including IP addresses, while the DDNS protocols automatically record the association between IP hosts and their DHCP-assigned addresses.

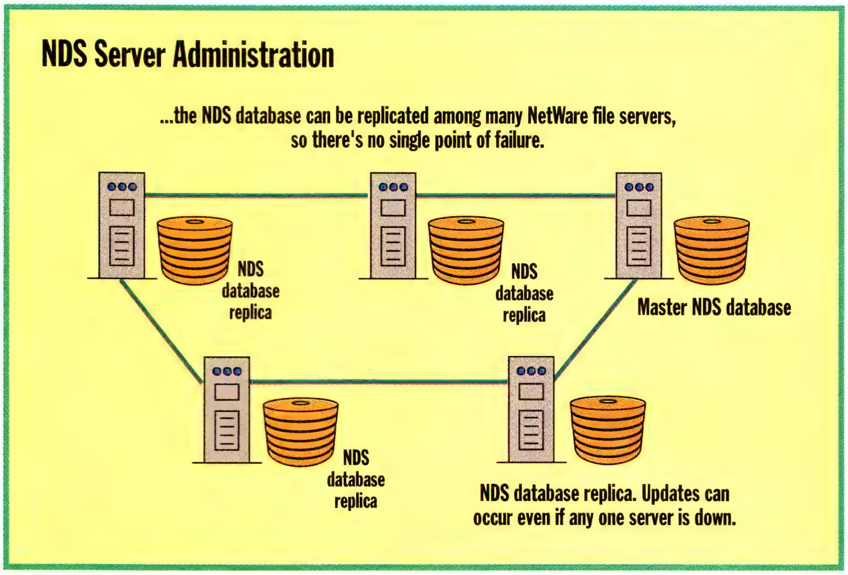
Using DHCP and DDNS, a host automatically configures itself for network access wherever it connects to the IP network. Users can locate and access that host using its permanent, unique DNS host name. Mobile hosts, for example, can therefore freely move about a network without knowledge of the local IP network addresses or services and without end-user or administrator intervention.

Microsoft ships partial support for dynamic IP in NT Server. Dynamic assignment of IP addresses in Windows NT, which Microsoft calls Windows Internet Naming Service (WINS), works only with NetBIOS-based systems. WINS works with NetBIOS-over-TCP/IP to automatically insert names in the NetBIOS name table of another machine. WINS doesn't yet manage names and Internet IDs for pure TCP/IP networks. Managing NetBIOS name tables is relatively easy, even from a remote machine.

Enzo Schiano, who is the NT product manager at Microsoft, says that the Internet standard for dynamic IP is not yet a final one and Microsoft didn't want to attempt support for a moving target. You'll have to wait for the company to support anything other than NetBIOS-over-TCP/IP. The WINS feature works only if your protocol stack has NetBIOS


NT Server Administration
Central Domain Database
Primary Domain Controller (PDC)
Backup copy of Domain Database
Backup Domain Controller (BDC)
Backup Domain Controller (BDC)
Backup copy of Domain Database
With NT domains, changes to the central database can occur only on the central PDC, which presents a single failure point if the PDC is down...

NT replicates domain information across primary and backup servers.


NDS Server Administration
...the NDS database can be replicated among many NetWare file servers, so there's no single point of failure.
NDS database replica
NDS database replica
Master NDS database
NDS database replica
NDS database replica. Updates can occur even if any one server is down.

NDS replication doesn't depend on a single, primary database.

running on top of TCP/IP. Pure TCP/IP networks can't take advantage of WINS.

IBM decided to implement the not-yet-final draft standard in OS/2 Warp Server, which shipped in March. Warp Server includes an IETF-compliant integrated DHCP/DDNS package that lets any computer configure itself for IP network access whenever it plugs into the IP network. All DDNS addresses are updated, not just the subset of NetBIOS addresses. The OS/2 Warp Server package includes a Dynamic IP client, a DHCP server, and a DDNS server. The Dynamic IP client consists of both DHCP and DDNS client components.

The DHCP client can be configured to operate as a simple DHCP client or as a Dynamic IP client, integrating DDNS client services with the DHCP client. The Warp DHCP clients and servers support DHCP user classing, a new DHCP extension for administering groups of network hosts with common configuration requirements (e.g., an accounting department), independent of where the hosts in the network are. IBM's Dynamic IP is a general IP networking solution that has broad application; works with Unix, Windows, Mac OS, and OS/2 clients; and scales easily to an entire intranet.

Administration

NT's graphical administration interface makes it easy to perform many common tasks, such as adding users to a single domain. However, NT encounters some difficulties when administering a large network. Microsoft's System Management Server (SMS) attempts to address some of these problems, but it still has some shortcomings.

SMS supports desktop management and provides a set of management services that includes hardware and software inventory, software distribution and installation, remote desktop management, and LAN troubleshooting. SMS runs on NT Server and relies on NT Server's built-in management agents to collect network traffic and server performance data.

However, SMS is a desktop management platform, and it lacks the functionality of an enterprise management system such as those sold by Novell, IBM, and Hewlett-Packard. SMS focuses on management of the desktop hardware and software on the network but ignores the remainder of the network, such as network infrastructure components (i.e., hubs and routers), servers, network services, and non-Windows clients. Many network problems (e.g., not being able to print) involve more than just Windows-based desktop clients, and SMS often cannot help solve the problems that crop up on typical networks.

StreetTalk Access for Windows NT

StreetTalk, the resource-naming convention in Banyan Vines, has an excellent reputation for ease of use. StreetTalk predates X.500, yet it offers most of the same benefits. For sites that use Novell's NetWare, Banyan sells Enterprise Network Services (ENS) for NetWare. For NT-based LANs, Banyan licenses its StreetTalk Access for Windows NT File and Print. StreetTalk Access provides location-independent resource names that administrators can use, for instance, to migrate a print server from one domain to another without updating user profiles.

Released in March, StreetTalk Access is a directory services add-on for NT Server that supplies features missing in NT Server itself. Through StreetTalk Access, administrators can forget domain-based resource maintenance. StreetTalk Access allows users to log on to the network even if the server holding the user's profile is inaccessible. StreetTalk has SNMP support for integration with such network management products as OpenView. StreetTalk Access, which replaces the Microsoft redirector network client on NT machines, can run on either the Vines IP or TCP/IP protocols.

Besides supporting NetWare, Banyan's ENS works with Solaris, AIX, HP-UX, and SCO Unix. StreetTalk Access targets NT Server environments.

StreetTalk Access is available to users with Vines 5.5 or higher or ENS for Unix and Windows NT Workstations 3.51 or Windows NT Server 3.51. It costs $1495 per server plus $40 per user.

ENS for NetWare, which began shipping last year, supports DOS, OS/2, Windows, and Mac clients. ENS Server costs $3995. Prices for ENS for NetWare range from $295 for five users to $995 for 25 users and $5495 for 1000 users, with other increments in between.

NT Server doesn't offer per-user disk space limits (a feature that NetWare and Warp Server provide), and it lacks the ability to send alerts to network management products such as OpenView and NetFinity. NT Server also does not yet support DMI, a network management standard designed and agreed on by virtually every LAN vendor. The DMI specification, along with sample driver source code, has been available since 1994.

Through hierarchical storage management (HSM), NetWare allows the seamless migration of unused files to a near-line (as opposed to off-line) storage facility, such as a read/write CD-ROM jukebox, after a configurable period of inactivity. NT Server does not support HSM.

PRODUCT INFORMATION

StreetTalk Access $1495 per server plus $40 per user
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Westborough, MA
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fax: (508) 898-1755
www.banyan.com
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Windows NT 3.51 Server, $699;
single-user client license, $39.95;
Systems Management Server, $649 per server;
$39.95 per client
Microsoft Corp.
Redmond, WA
(206) 882-8080
fax: (206) 883-8101
www.microsoft.com
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On the other hand, says Schiano of Microsoft, the next version of NT Server will take advantage of a new dial-up protocol for connecting to a server through the Internet. Called Point-to-Point Tunneling Protocol (PPTP), it won't alleviate data-routing delays on the Internet but will allow remote-LAN access via an Internet service provider (ISP). Microsoft and 3Com jointly developed the PPTP specification, which they hope ISPs and other network software vendors will embrace.

NT Server certainly has the potential to become a scalable NOS for large organizations. When Microsoft adds directory services, better network management, client support for OS/2-based PCs, and a complete dynamic IP feature, NT Server could find its way onto some very large networks. For now, NT Server works well on networks with Windows-only clients running NetBIOS over TCP/IP and that have simple relationships between domains, users, and resources.

Barry Nance is a BYTE consulting editor and has been a programmer for 25 years. He is the author of Using OS/2 Warp *(Que, 1994),* Introduction to Networking *(Que, 1994), and* Client/Server LAN Programming *(Que, 1994). You can contact him on the Internet at* **barryn@bix.com**.

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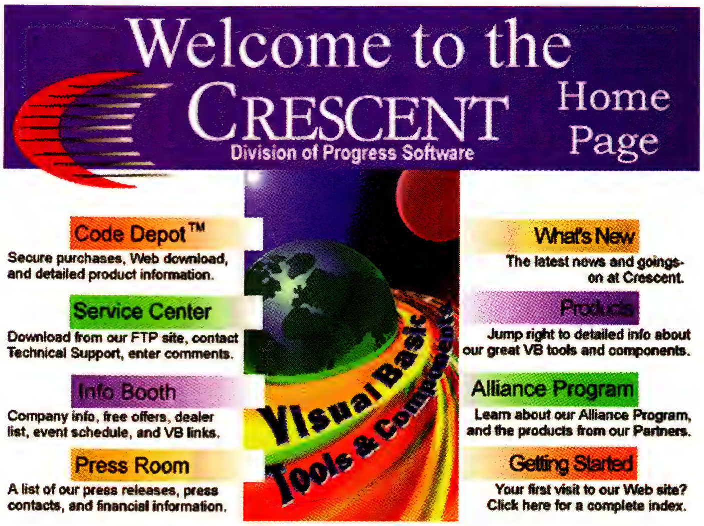

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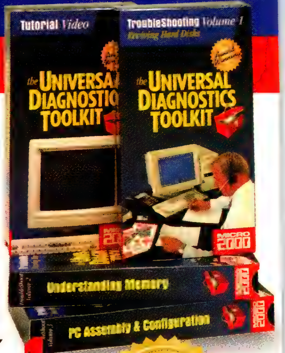
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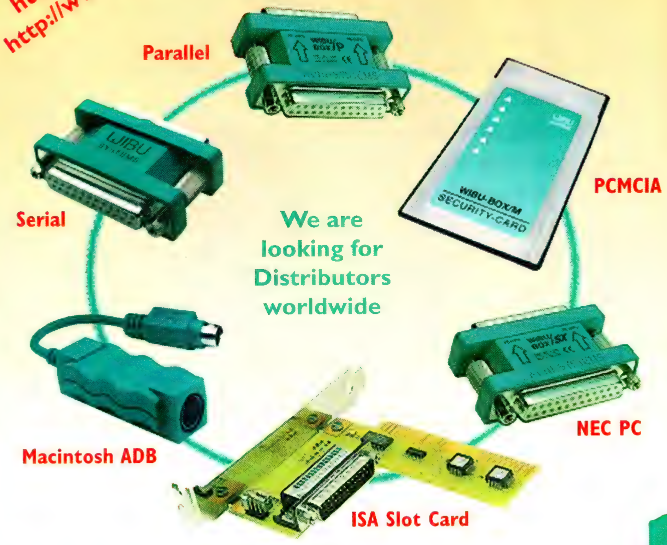

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The 1996 Readers' Choice Awards

Our readers pick the best hardware and software on the market today.

By Tom Thompson

Iomega's Zip drive, which is this year's Hardware Product of the Year, reflects the dual interests of BYTE readers. On the one hand, our readers are keenly interested in innovative technologies. That's one reason why the fast access time and play-with-any-platform capabilities of the Zip drive made it the winner in the hardware category. The Zip drive now ranks with such previous Hardware Product of the Year winners as Apple's Power Mac and Intel's Pentium processor.

BYTE readers also have a pragmatic bent, which the Zip drive satisfies. With today's systems sporting 1-GB and larger hard drives, backing up contents has become a major problem. The Zip drive's price tag of $200 and removable 100-MB cartridges costing only $20 apiece make a cost-effective solution for fast, inexpensive backup and storage.

Pragmatism also influenced the voting for Software Product of the Year. Once all the Windows 95 hype subsided, BYTE readers looked at the revitalized OS and liked what they saw enough to give it top honors. However, the runners-up, Netscape Navigator and IBM's OS/2 Warp Connect, portend the growing importance of Internet access in the minds of BYTE readers.

Service is still one of the most important categories in the awards competition, and Gateway 2000 continues its roll. For the third straight year, BYTE readers voted Gateway the company that provides the best service.

The clearest message of all is that only the fittest survive when hardware and software designers constantly try to best each other. Here are the current leaders in this competition.

Hardware Product of the Year

Zip drive, Iomega
Runners-up:
ThinkPad 760, IBM
Power Mac 8500, Apple

Software Product of the Year

Windows 95, Microsoft
Runners-up:
Navigator 2.0, Netscape
OS/2 Warp Connect, IBM

Company with the Best Service

Gateway 2000
Runners-up:
Dell Computer
Hewlett-Packard

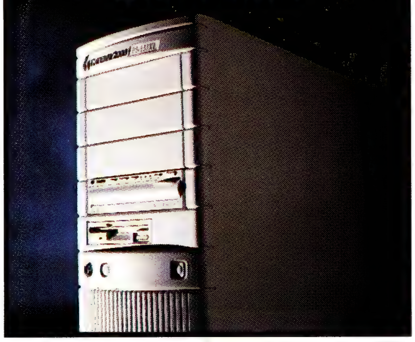
BEST HARDWARE PRODUCT

Iomega Zip Drive

BEST SOFTWARE PRODUCT

Microsoft Windows 95

BEST SERVICE



Gateway 2000

Hardware

Desktop Computers–PC

Gateway 2000 P5-166XL, Gateway
Runners-up:
Gateway 2000 P5-133XL, Gateway
Dell Dimension XPS P100t, Dell

Desktop Computers–Mac

Power Mac 8100, Apple

Power Mac 8100

Runners-up:
Power Mac 7200, Apple
Power Mac 8500, Apple

Workstations

HP 9000, Hewlett-Packard

HP 9000

Runners-up:
IBM RS/6000, IBM
IBM Power Series 850, IBM

Notebook Computers

ThinkPad 760, IBM
Runners-up:
Mac PowerBook series, Apple
LTE Elite series, Compaq

Ultra Portables

ThinkPad 701C, IBM
Runners-up:
HP OmniBook 600,
Hewlett-Packard
Portégé 610CT, Toshiba

Hand-Held Computers

Newton MessagePad 120, Apple
Runners-up:
HP OmniGo 100, Hewlett-Packard
Sharp Wizard series, Sharp

Monitors

NEC MultiSync FG, NEC
Runners-up:
AppleColor RGB, Apple
Valugraph 447L, Nokia

Laser Printers

HP LaserJet 4Si, Hewlett-Packard
Runners-up:
HP LaserJet 4P, Hewlett-Packard
HP LaserJet 5P, Hewlett-Packard

Color Printers

HP DeskJet 660C, Hewlett-Packard
Runners-up:
Epson Stylus Color II, Epson
Canon BJC-4100, Canon

Modems

Sportster series, U.S. Robotics
Runners-up:
Practical Modem PM9600SA,
Practical Peripherals
Accura series, Hayes

Video Boards–PC

System Stealth 64,
Diamond Multimedia
Runners-up:
MGA Millennium, Matrox
Imagine 128, Number Nine

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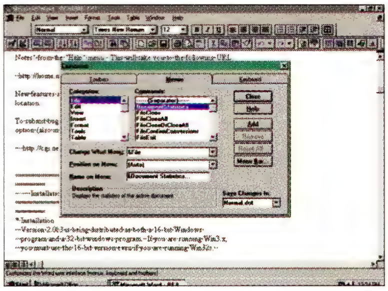
Video Boards–Mac

MGA Millennium for PCI Power Mac, Matrox
Runner-up:
Imagine 128 for Mac, Number Nine

Software

Word Processor–DOS, Win, OS/2

Microsoft Word for Windows, Microsoft



Microsoft Word

Runners-up:
WordPerfect for Windows, Corel
Lotus Word Pro, Lotus

Word Processor–Mac

Microsoft Word, Microsoft
Runners-up:
WordPerfect, Corel
MacWrite Pro, Claris

CAD–DOS, Win, OS/2

AutoCAD, Autodesk
Runner-up:
DesignCAD 3D, Viagrafix

CAD–Mac

Claris CAD, Claris
Runner-up:
Vellum, Ashlar

Contact Managers/PIMs

Lotus Organizer, Lotus
Runners-up:
Act, Symantec
Ecco Pro, NetManage

Database Managers–DOS, Win

Microsoft Access, Microsoft
Runners-up:
Paradox for Windows, Borland
FoxPro, Microsoft

Database Managers–Mac

FileMaker Pro, Claris
Runners-up:
4th Dimension, ACI US
Omnis, Blyth Software

Database Client/Server

InterOffice Server, Oracle
Runners-up:
Microsoft SQL Server, Microsoft
Informix Universal Server, Informix

Desktop Publishing–DOS, Win

PageMaker, Adobe
Runners-up:
FrameMaker, Adobe
Microsoft Publisher, Microsoft

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PageMaker, Adobe
Runner-up:
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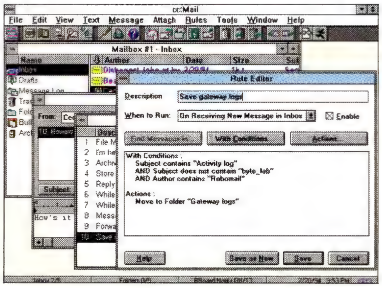
Runners-up:
Microsoft Mail, Microsoft
Lotus cc:Mail, Lotus

E-Mail & Workgroup–Mac

Lotus cc:Mail for Mac, Lotus



Description: Save gateway logs
When to Run: On Receiving New Message in Inbox ☒ Enable

With Conditions :
Subject contains "Activity log"
AND Subject does not contain "byte_lab"
AND Author contains "Robomail"

Actions :
Move to Folder "Gateway logs"

Lotus Notes

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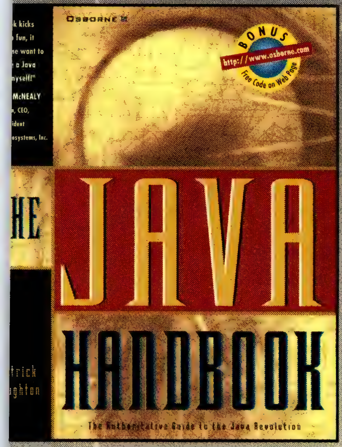

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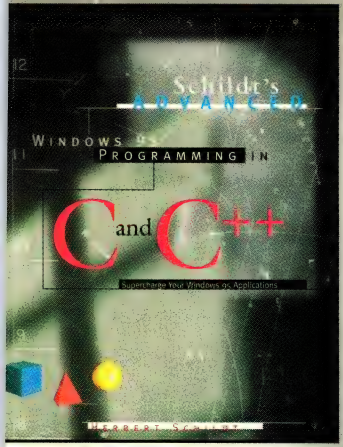

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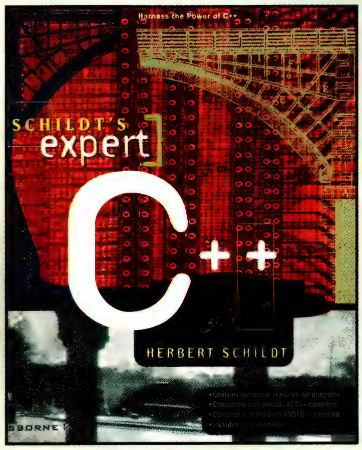

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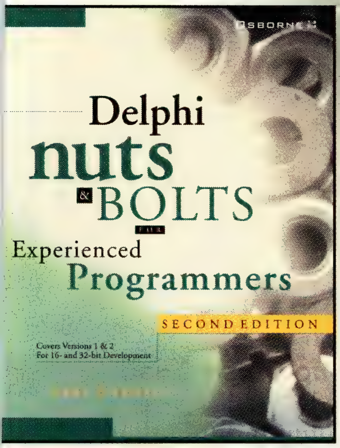

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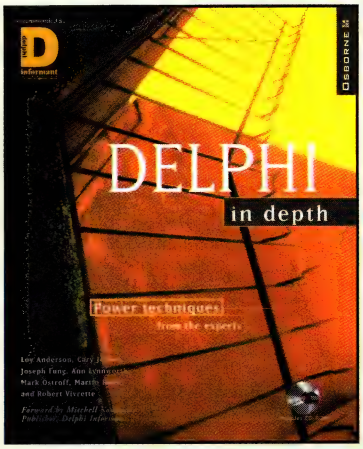

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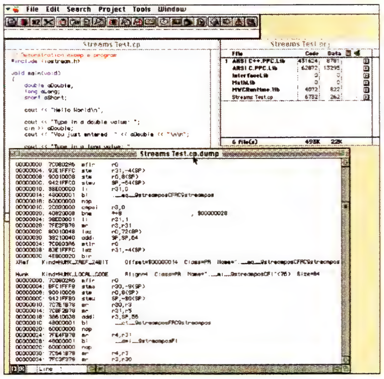

```
#include <iostream.h>

void main(void)
{
    double aDouble;
    long aLong;
    short aShort;

    cout << "Hello World\n";

    cout << "Type in a double value: ";
    cin >> aDouble;
    cout << "You just entered " << aDouble << "\n\n";
```

File	Code	Data
ANSI C++.PPC.Lib	431624	8781
ANSI C.PPC.Lib	62872	13295
InterfaceLib	0	0
MathLib	0	0
MWCRuntime.lib	4072	822
Streams Test.cp	6732	262
6 File(s)	498K	22K

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The Network in the Server

Leading-edge server designs are adopting network-like system architectures to boost performance and improve scalability.

By Tom Thompson

Multiple processors linked with high-speed data pathways—sounds like standard networking fare, right? Wrong. There's nothing standard about the types of networks that are appearing from a growing number of server vendors: These networks are *inside* the computer.

Two new system architectures, from Tandem Computers and Sequent Computer Systems, typify this hot trend in server design. Just in time, too. Today's servers must often store gigabytes of complex data sets and juggle thousands of on-line transactions or queries each hour. Many businesses also expect their servers to supply video on-demand for in-house training sessions, manage numerous Internet connections, and help mine information from companywide data warehouses.

These kinds of jobs can quickly overwhelm a server that's little more than a souped-up desktop computer. Next-generation servers must efficiently manage resources on a far larger scale—gigabytes of memory, multiple CPUs, dozens of I/O ports, stacks of disk arrays, and piles of peripherals.

To meet these challenges, Tandem has designed a novel system architecture that ties a server's processors, memory, and peripherals together with a mesh of high-speed connections and smart switches. Like any intelligent network, this architecture allows basic I/O operations, such as memory fetches and peripheral accesses, to explore alternate paths when the system is laboring under heavy loads.

Sequent has designed a new server architecture that's equally clever. It lets you assemble a scalable system from basic building blocks of processors and local memory, all tied together with a high-speed communications link. This architecture also resembles a network.

Tandem and Sequent aren't the only server vendors to see the merits of these architectures. NEC has announced support for Tandem's architecture in its RISC-based Windows NT servers. Compaq and Tandem have jointly announced a PCI board that lets you tie together servers via a special network so they can share resources—a technique known as *clustering*. Using Windows NT 4.0, this clustering arrangement provides a "fail-over" capability: If one server crashes, the others automatically step in to handle the load.

Tandem's ServerNet

Most servers today are based on a parallel-processing model in which multiple CPUs divide and conquer the work load. There are two general approaches to this model: symmetric multiprocessing (SMP) and massively parallel processing (MPP), and each has its own tradeoffs (see "The World's Fastest Computers," January BYTE). Tandem's new architecture, known as ServerNet, gives you the flexibility to build either type of system. This is the foundation for Tandem's Integrity S4000 servers.

ServerNet has three components (see the figure "The ServerNet Architecture" on page 152). The first is a low-cost, high-speed router. Tandem uses several arrays of these routers to construct a packet-switched, point-to-point, interconnected mesh inside the server. This is called the system area network (SAN), to distinguish it from the LAN outside the computer.

The second ServerNet component is a processor-interface chip, which is implemented as an ASIC. This custom chip provides the critical connections between the processors, their local memory, and the router network. With this arrangement, the majority of the processor-to-memory transfers remain local to the processor-interface ASIC—they don't have to venture onto the SAN.

Also, depending on how the designers arrange the processors and memory, it's possible to build either an SMP or an MPP system with ServerNet. For example, the processor-interface

ILLUSTRATION: STEVE MUNDAY © 1996

ASIC might share a bank of memory among several processors, thus creating an SMP system. Finally, the processor-interface ASIC is dual-ported, so a server with duplicate SANs can form a fault-tolerant system.

Rounding out ServerNet is the third component, a peripheral-device-interface ASIC. This chip provides SAN connections to communications devices (e.g., external network interfaces) and to standard I/O buses (e.g., PCI and SCSI). All the ServerNet ASICs have built-in error-checking logic, so designers can use them in fault-tolerant servers.

Each SAN router has six bidirectional ports, so designers can arrange the server elements in a wide variety of internal topologies—including meshes, trees, and hypercubes—depending on the requirements of the server applications. The routers can rapidly switch data among the SAN's various I/O devices and compute nodes. (A *compute node* consists of one or more processors and local memory.) Playing the role of traffic cop, the routers can transfer data between individual compute nodes, between nodes and I/O devices, and between different I/O devices.

Because all the data moves directly among these elements and not through a central bus, ServerNet is much more efficient than a traditional design. Signal paths are shorter, and the routers can find alternate pathways; thus, there's less chance of a bottleneck during heavy system loads.

The Smart Switch

It's worth looking at the ServerNet routers in more detail to see how they make such a distributed system architecture possible. As mentioned earlier, each router has six bidirectional serial data links, or ports. Each port has two transmit channels and two receive channels; each channel consists of a 9-bit command/data bus and a clock signal. Every channel uses a 9-bit token that encodes 256 data symbols and 20 command symbols. The command symbols are for initialization, error detection, and low-level flow control. The ports employ differential logic to drive signals through cables up to 30 meters long.

Data packets on the SAN can be up to 80 bytes long. Each packet has an 8-byte header, a 4-byte ServerNet address, a variable-length data payload that can range up to 64 bytes, and a 4-byte checksum (a cyclic redundancy check). The header byte specifies the type of operation to perform (read request, read response, write request, write response, and so on). It also contains routing information—a pair of 20-bit IDs that specify the packet's source and destination—and the length of the data payload. This small packet size reduces network transfer latencies. It also minimizes buffering requirements, resulting in a more economical router design.

The router itself has first-in/first-out (FIFO) buffers for the input data, some arbitration and control logic, a RAM-based routing table, and a 6 by 6 crossbar switch that links all the data channels. ServerNet uses *wormhole routing* instead of a store-and-forward mechanism to further reduce network transfer latencies.

Wormhole routing is a technique in which the router begins forwarding an incoming packet to its destination before the entire packet is received. As the packet's first few header bytes arrive, the router's control logic extracts the destination ID and uses this value as an index into the routing table. The routing table returns the number of the output port that points to the packet's destination router. If that port is busy, the incoming bytes drop into the router's FIFOs. The control logic issues a flow-control command to throttle the sending router until the port becomes available.

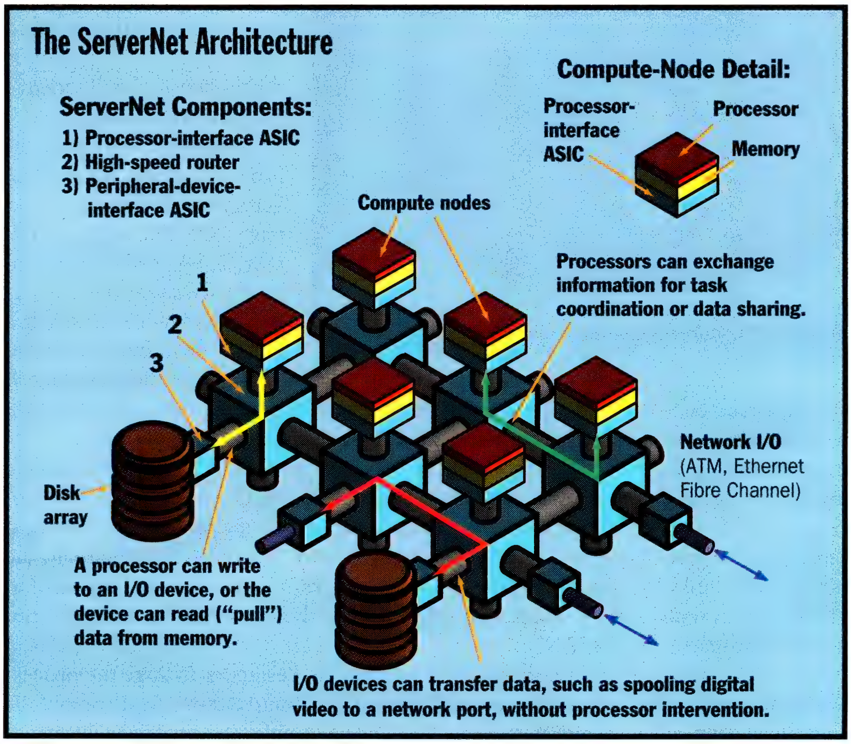
In addition, both the processor-interface and peripheral-device ASICs can "pull" (read) as well as "push" (write) data. This accommodates I/O devices with different speeds and buffer sizes by allowing them to pull data from memory as they need it. Pulling data also enables ServerNet to support many active I/O devices simultaneously without resorting to a multithreaded DMA engine.

Current ServerNet implementations use Tandem's NonStop-UX OS, based on Unix System V release 4.2 MP. In a ServerNet system that implements an SMP architecture, applications programs should run without modification. The OS code and drivers need some work to support the direct availability of all I/O devices to all compute nodes. For ServerNet systems based on an MPP architecture, developers must modify their applications programs to support message passing—a requirement of MPP, not ServerNet.

Thanks in large part to wormhole routing, the latency of a ServerNet router is only 300 nanoseconds per hop. The latency of a zero-length message (e.g., a read response) can be as low as 1 microsecond for a single-level router path. With a full 80-byte packet on a large ServerNet, the latency is 3 μs. The effective data transfer rate between routers is 40 MBps.

But perhaps more significant is the aggregrate transfer rate. Because the rout-

The ServerNet Architecture

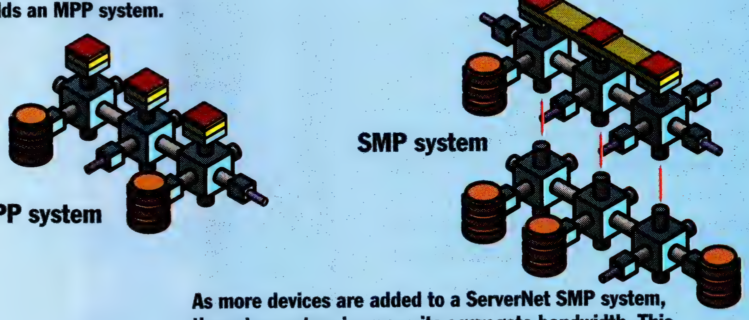

ServerNet Components:
1) Processor-interface ASIC
2) High-speed router
3) Peripheral-device-interface ASIC
Compute-Node Detail:
Processor-interface ASIC
Processor
Memory
Compute nodes
1
2
3
Processors can exchange information for task coordination or data sharing.
Network I/O (ATM, Ethernet Fibre Channel)
Disk array
A processor can write to an I/O device, or the device can read ("pull") data from memory.
I/O devices can transfer data, such as spooling digital video to a network port, without processor intervention.

ers have multiple interconnections to processor nodes and devices, a ServerNet SAN can deliver spectacular performance. Tandem claims that a system with 4096 compute nodes and peripherals—and with 4680 to 7680 routers arranged in a fractahedral topology—can achieve an aggregate switching bandwidth of 410 GBps. By comparison, some supercomputers have a maximum switching bandwidth of only 1.2 to 2 GBps. (To be fair, these supercomputers achieve this rate with only 32 processors, not 4096.)

ServerNet's Flexible Design

If the processor-interface ASIC provides each processor with its own local memory, ServerNet builds an MPP system.

If the processor-interface ASICs share local memory with several processors, ServerNet builds an SMP system.



As more devices are added to a ServerNet SMP system, the extra routers increase its aggregate bandwidth. This permits scalable I/O without imparing system performance.

ServerNet's distributed architecture, though complex, offers a number of advantages. By providing alternate data paths, it dramatically reduces system bottlenecks and achieves a high switching bandwidth. Since the routers manage data transfers, they relieve the system processors of this job, which is especially significant for I/O. Perhaps most important, the ServerNet architecture offers scalability for different types of server architectures (see the figure "ServerNet's Flexible Design" above).

MPP systems can use ServerNet as a high-speed connection mesh between various compute nodes and peripherals. SMP servers can use ServerNet routers and peripheral-interface ASICs to provide scalable I/O (e.g., increasing the number of Ethernet connections or boosting disk storage) without degrading the performance of the OS or applications software. Because of its point-to-point network capabilities, ServerNet also allows you to expand server capacity by clustering.

Finally, you can use ServerNet to build a fault-tolerant server by connecting two duplicate systems through the dual ports of the processor-interface ASICs. The error-checking logic in the ServerNet ASICs monitors all transfers. If either the processor-interface ASICs or the routers detect an error, they can trigger a recovery protocol that disables the offending component.

Building Blocks

While Tandem takes a distributed interconnection approach among server components to boost server bandwidth, Sequent favors a modular architecture in which the server is built out of high-performance building blocks mortared together with high-speed communications links. Sequent refers to each block in this structure as a *Quad*, because each one consists of four Pentium Pro CPUs on a multiprocessor system bus. The Quad thus takes advantage of the Pentium Pro's built-in four-way multiprocessor bus, which handles bus arbitration and resource control (see "How to Make Pentium Pros Cooperate," April BYTE).

Each Quad has 512 MB to 4 GB of RAM, seven PCI slots, special communications logic, and 32 MB of cache RAM. The communications logic is the intelligent interconnection between the memory of two or more Quads.

By assembling multiple Quads, you can build a low-latency, scalable SMP server. Of course, if Sequent had stopped there, you'd still have the problem of bus saturation when you added more processors. Sequent's ingenious solution to this is to operate each Quad's multiprocessor bus independently, like the separate buses in an MPP system.

Unlike in an MPP system, however, the communications logic interconnects each Quad's RAM so that the distributed memory behaves like a global block of shared memory. Sequent refers to this communications logic as "IQ-Link" because it intelligently manages memory I/O. Only when a Quad accesses memory in another Quad does the transaction cross the interconnection bus. Because this bus handles only the occasional global memory access, it can manage a large-scale SMP system with more than eight CPUs.

Note that accesses to a Quad's local memory are fast (250 ns), while off-Quad accesses are slower (3 μs). Because different parts of the system have different memory latencies, this mechanism is known as *nonuniform memory access*, or *NUMA*. The IQ-Link transparently maintains data coherency among all the separate blocks of memory. It's similar to the way a processor's on-chip cache operates, which is why the IQ-Link's mechanism is sometimes described as a *cache-coherent* NUMA (CC NUMA). Sequent calls this NUMA with Quads, or NUMA-Q.

Home on the RAM

Programs tend to access memory in closely related groups of addresses due to tight code loops or sequential searches through data arrays. This behavior is known as *locality of reference*, and it's an important factor in the high performance of a Sequent NUMA-Q. It means that most references won't stray beyond a Quad's local memory and that those references that access global memory will return more quickly, thanks to the high-speed IQ-Link.

Part of the time, in fact, a Quad's Pentium Pro processor will find the data it needs in its primary (L1) or secondary (L2) caches. (Remember, the Pentium Pro has a 256- or 512-KB secondary cache closely coupled to the CPU in a multichip package.) If the CPU can't find what it needs in the L1 or L2 caches, the cache miss will most likely fall within the Quad's local memory. If not, the IQ-Link first searches the Quad's own 32-MB cache, which Sequent describes as an L3 cache. This is a directory-based cache that holds copies of data from other Quads, and its latency is the same as that of local memory.

Only when the CPU misses the L3 cache does the IQ-Link issue a request on the interconnect bus to access distant memory, as shown in the figure "Keeping

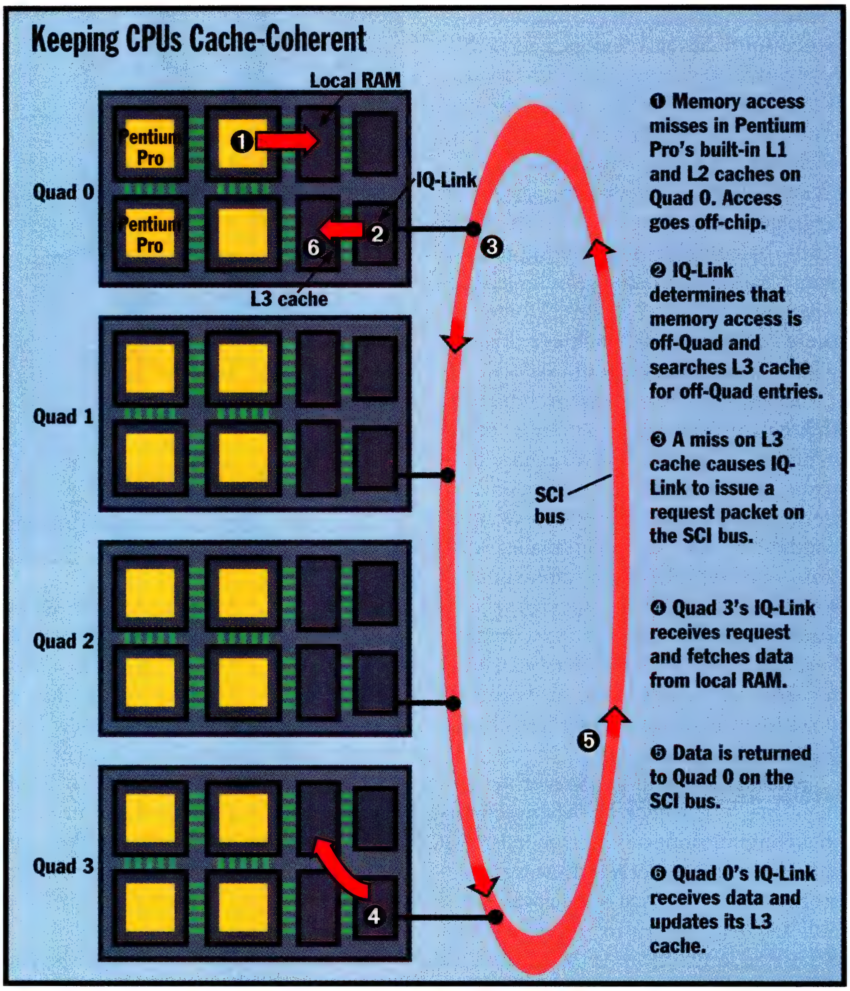
CPUs Cache-Coherent” at right. This bus is based on the IEEE 1596-1992 Scalable Coherent Interconnect (SCI) standard. It’s a one-way, point-to-point loop that connects the Quads together in a daisy chain. It uses a packet-based protocol that supports cache-coherent distributed/shared memory. In this sense, the SCI bus also resembles a network.

When a Quad’s IQ-Link logic receives a request packet over the SCI bus, it fetches the requested data from local memory. The data circles the SCI loop to the Quad that made the request and then arrives in that Quad’s L3 cache. Because the address spaces of each Quad’s local memory don’t overlap, these transfers merely update the Quad’s L3 caches; they don’t explicitly copy the data into local memory. To maintain memory coherency, the IQ-Link relays any modifications, such as setting a semaphore, to the appropriate L3 caches of other Quads.

IQ-Link and the SCI bus thus segment a NUMA-Q system’s Quads in a manner similar to the way in which a LAN segments a computer network. That is, programs get quick access to the most often-used data (because it’s in a Quad’s local memory or in the L3 cache), while accesses to less frequently used data need only go through the SCI “backbone.” Because off-Quad references are infrequent, the SCI bus remains uncongested; thus, larger SMP systems can be built around a NUMA-Q design.

The data-pump ASICs for the SCI bus are made of gallium arsenide—a more exotic semiconductor than conventional silicon—and can transfer 1 GB of data per second. A Quad’s multiprocessor bus can achieve a bandwidth of 500 MBps. Because the NUMA-Q architecture can manage up to 63 Quads (252 processors) using only one instance of the OS, the aggregate system bandwidth of a server can reach nearly 32 GBps.

Not enough power? You can, of course, cluster several NUMA-Q nodes together in an external Ethernet, asynchronous transfer mode (ATM), or Fibre Channel network. In this arrangement, each SMP node runs its own copy of the OS and applications while sharing disks and communications peripherals with other nodes. Since each Quad has a PCI interface, you can distribute peripherals throughout the system to reduce competition for I/O devices. You have a choice of two OSes: DYNIX/ptx (Sequent’s SMP-enhanced Unix) or Windows NT.


Keeping CPUs Cache-Coherent

❶ Memory access misses in Pentium Pro’s built-in L1 and L2 caches on Quad 0. Access goes off-chip.

❷ IQ-Link determines that memory access is off-Quad and searches L3 cache for off-Quad entries.

❸ A miss on L3 cache causes IQ-Link to issue a request packet on the SCI bus.

❹ Quad 3’s IQ-Link receives request and fetches data from local RAM.

❺ Data is returned to Quad 0 on the SCI bus.

❻ Quad 0’s IQ-Link receives data and updates its L3 cache.

In a sense, NUMA-Q offers the best features of SMP and MPP architectures. To software, it looks like an SMP system, so existing applications can take advantage of the extra processing power and larger memory space without modification. Threaded OSes can readily distribute tasks among the various processors for load balancing. Yet you get the scalable I/O of an MPP system, because each Quad has its own I/O ports, and the IQ-Link minimizes systemwide bus traffic while maintaining memory coherency.

The Future Is Networks

If ServerNet and NUMA-Q are any indications of things to come, tomorrow’s servers will differ greatly from conventional desktop computers. Their architectures will certainly be much more complex. Instead of using just a couple of buses for memory and device I/O, they will resemble a mesh of interconnected components. However, this complexity will pay off with high performance that will be able to successfully tackle the demands of tomorrow’s server applications.

In addition, the servers of tomorrow will be more scalable and custom-tailored for the particular job at hand. With technologies such as ServerNet and NUMA-Q, you can assemble as many elements as you need for a particular job’s processing requirements. As your needs grow, you can add more processing power or storage capacity. **B**

Tom Thompson is a BYTE senior technical editor at large. He has a B.S.E.E. degree from the University of Memphis and is author of the book PowerPC Programming Kit *(Hayden Books, 1996). You can reach him by sending e-mail to* **tom_thompson@bix.com.**

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Sequent Computer Systems	Tandem Computers
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Comparison

Web Building Tools

Microsoft and Netscape try to ease the pain of developing and maintaining a Web site. **By Rex Baldazo**

Battle of the Web Site Builders

Netscape and Microsoft's epic struggle for mind and market share in the Internet arena now involves the tools for creating and managing Web site content. On this latest front, the weapons of choice are Microsoft's FrontPage and Netscape's LiveWire.

Both packages help you deal with the everyday chores of creating useful Web content and keeping it up to date. Both provide Hypertext Markup Language (HTML) authoring tools, check for broken links, and offer wizard-style functions to help create a complete Web site. Both can also create interactive content—FrontPage with its WebBot add-ons and LiveWire through its JavaScript support. But the two products are targeted at different users and attack site construction quite differently.

As Microsoft tightens integration with the rest of the Office suite, its FrontPage looks attractive for people who want to use a Web server to store and distribute corporate documents on an intranet. But it is clearly not intended to handle a large and complex site. (It was unable to import the complete BYTE Site.) LiveWire can handle any site, but there's a trade-off: LiveWire is substantially more complex than FrontPage.

Microsoft FrontPage

ADVANTAGES:

+ Excellent HTML editor
+ Great price/performance

DISADVANTAGES:

– Limited programmability
– Requires server extension

FrontPage Views

FrontPage came originally from Vermeer, a company Microsoft acquired in its efforts to catch Netscape. We tested a beta version of FrontPage 1.1, the first version to come out under the Microsoft banner.

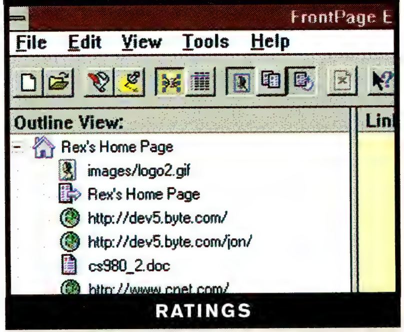
FrontPage includes the 32-bit Personal Web Server, but it can support other servers through a mechanism called the FrontPage server extension. An extension for O'Reilly's WebSite ships with the product, and additional extensions should be available by the time you read this. We tested the default Personal Web Server and its default server extension. The other major components are FrontPage Editor, for authoring in HTML, and FrontPage Explorer, for creating a Web site and then analyzing and maintaining the hyperlinks throughout the site.

FrontPage interacts with your site entirely through the server extension and never deals directly with the original HTML files. You edit local copies obtained from the Web server, then save them via the Web server. You can manage a remote Web site over a network or the Internet, which isn't the case with LiveWire.

The Explorer has two panes. The left pane holds a tree of the various pages comprising the Web site (see the screen), and the right pane is a graphical representation of the links to and from the selected page. When you double-click on a page in Explorer, it automatically opens the FrontPage Editor.

This editor has a number of useful features. You can create image maps directly without needing an external tool, and if you drag another page from the Explorer onto the page you are editing, the editor automatically creates a hyperlink to that page. The editor supports standard tags such as the creation of bookmark anchors within a page, as well as links to the bookmarks.

MICROSOFT FRONTPAGE



RATINGS

TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★

The new 1.1 version of the FrontPage Editor has a number of improvements. It now supports table editing, for example, though there is no direct support for Microsoft extensions to HTML such as table-cell background colors. You can include these attributes manually, but they are not displayed correctly in the FrontPage Editor.

Whereas adding unsupported attributes isn't difficult, incorporating entire unsupported HTML tags into your pages can be cumbersome. You can't type in these HTML elements manually because the editor will format them as displayed text. Instead, you must use a mechanism called a WebBot, which gives FrontPage its ability to go beyond creating simple static HTML pages. A variety of WebBots ship with the product.

Using the HTML WebBot, you can add in the HTML coding needed to create an element not supported directly by the FrontPage Editor. But all you see in the editor is the WebBot, not the HTML associated with it; for that, you must edit the properties for the HTML WebBot. In all, this is a tedious way to add plain old HTML text to a page.

WebBots, like the server extensions, are not something you can create with a scripting language. You have to develop them with a separate kit. Several WebBots come with FrontPage, including a handy form WebBot that can store the user's form input to a text file.

continued

Netscape LiveWire

ADVANTAGES:

+ Powerful server scripting
+ Can manage large Web sites

DISADVANTAGES:

– Steep learning curve
– Netscape servers only

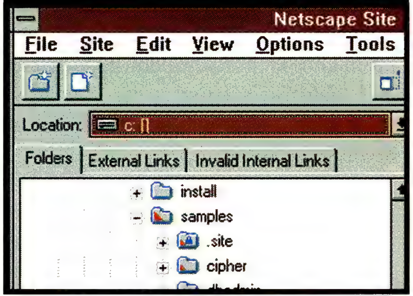
BYTE BEST

Playing with LiveWire

We tested the second beta of LiveWire. Netscape is notorious for labeling alpha products as beta. LiveWire did not disabuse us of this notion. We encountered numerous crashes and inconsistent performance from several LiveWire components.

LiveWire has these main components: SiteManager, roughly the equivalent of FrontPage Explorer; Navigator Gold 2.0, the HTML-authoring version of the Navigator 2.0 browser; and the LiveWire compiler and server extension. This component compiles server-side JavaScript and runs it on a Netscape Web server. It includes the AppManager to let you install and control the JavaScript applications.

NETSCAPE LIVEWIRE



RATINGS

TECHNOLOGY	★ ★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

Unlike FrontPage, LiveWire has to map the file system of the Web site it is managing. Remote administration of a site is still possible, but it isn't as easy as with FrontPage and entails the security risk of advertising the server's file system.

Like FrontPage Explorer, SiteManager has a two-pane interface, but it uses its panes differently. The left pane is essentially a file manager. If you already have a Web site, you have to bring it under management. SiteManager will then display those directories with a little red triangle to differentiate from normal directories. Of course, if you create a site using SiteManager it is automatically under management.

The Web site you're managing can also have a separate deployment directory. This allows you to develop and test your site in one directory, then deploy it in another directory. SiteManager automatically handles link management when deploying to another managed directory.

SiteManager's right pane is the property pane, which shows attributes related to the object currently selected in the left pane. For example, if you select an HTML file in one of your managed directories, the property pane displays the links to and from the page, as well as additional site properties. Both panes are tabbed windows, so you can easily view a rich variety of information with minimal mouse clicks.

As an HTML authoring tool, Navigator Gold 2.0 is a disappointment. We use Navigator 2.0 every day, and Gold 2.0 feels like a fairly natural extension of the browser. Even so, it compares poorly to FrontPage Editor. There is no support for table editing, for example. You can import a file with a table and edit the contents of individual cells, but Navigator Gold will not display the table in edit mode—it unrolls the table and displays it as a series of paragraphs. There is also no built-in image map editor, nor is there direct support for creating and manipulating either frames or JavaScript (LiveWire's greatest feature).

Only distantly related to Java, JavaScript is Netscape's scripting language. Now, with the LiveWire server extension, it's available on the server as well. JavaScript resides directly inside HTML pages, between the `<server>` and `</server>` tags. You can also use the backtick (`) character if you need to insert short JavaScript statements inside other HTML tags. The LiveWire package comes with a compiler that precompiles the JavaScript into run-time `.web` files.

The server extension creates a variety of objects as clients hit the server with their requests, and your server-side JavaScript has complete access to these objects. Server-side JavaScript also has access to the server's file system. A program called AppManager lets you install, start, and stop server-based JavaScripts. AppManager fronts through a Web browser interface.

Features Compared

	MICROSOFT FRONTPAGE	NETSCAPE LIVEWIRE
Web server support:		
Web server included	✓	
Servers supported:	WebSite, NCSA, CERN, Apache, IIS, Netscape	Netscape 1.2 and later
Editing features:		
Edit a page directly from Web server	✓	
Create image maps	✓	
Create/edit tables	✓	
Edit Microsoft extensions		
Edit Netscape extensions	Supports some Netscape extensions.	
Interactive features:		
Database connectivity		✓[1]
User scripting		✓
Site management:		
Link checking	✓	✓
Graphical link display	✓	
Site templates	✓	✓
Import existing site	✓[2]	✓
Migrate a site	✓[3]	✓[4]

[1] Lacks LiveWire Pro's integrated database.

[2] Unable to handle a large site (i.e., the BYTE Site).

[3] FrontPage Server Extension must be running on both the source and the destination Web servers.

[4] Can migrate a site to a different directory as long as it is on one of the mounted disk drives.

✓ = yes

PRODUCT INFORMATION

FrontPage $149 (introductory)
Microsoft
Redmond, WA
(206) 882-8080
www.microsoft.com/frontpage
Circle 1088 on Inquiry Card.

LiveWire $295
Netscape Communications
Mountain View, CA
(415) 937-2555
www.netscape.com/
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This proliferation of browser-fronted applications is LiveWire's Achilles' heel. You can easily end up with a half-dozen instances of Navigator running at once—one to edit the HTML, another running AppManager, another viewing the JavaScript being tested, another running the Trace utility that lets you debug your JavaScript, another opened to the LiveWire documentation, and another pointed at the JavaScript documentation. And we were also running the FastTrack server on the same machine.

Microsoft's FrontPage is the best route for less-complex Web sites, especially if you use Microsoft Office. It's also best for remote management of a site. LiveWire is adept at creating richer, more interactive content, particularly when you take advantage of server-side JavaScript and use it with database-enabled LiveWire Pro. But only if you're adept at using it. B

Rex Baldazo is a BYTE technical editor. You can reach him at **rbaldazo@bix.com.**

Borland's new C++ 5.0 Development Suite carries your application from inception to deployment. **By Rick Grehan**

Womb-to-Tomb C++ Development

When we last reviewed C++ compilers (see "Compiling Convenience +," March BYTE), Borland's version 4.5 was fast fading and we decided to wait for 5.0, which was rapidly approaching in the distance. We're glad we did. Borland C++ (BC++) 5.0 is a major release with so many new attachments that we'd be hard-pressed to cover them all.

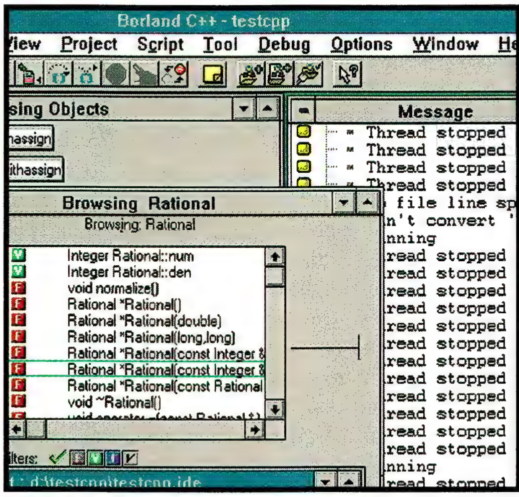
It comes in two versions. The regular version includes BC++ 5.0, the 16-bit hosted version of BC++ 4.5, Visual Database Tools, and Object Windows Library (OWL) 5.0. The large version is the Development Suite that we reviewed; it adds CodeGuard, PVCS, InstallShield Express, and Java support.

Staying with the Trends

Given the frequency of new compiler releases, trends are easy to recognize. Any organization dealing even remotely with software development is trying to fold Java into its recipe. Unlike Symantec (with its stand-alone Cafe), Borland supports Java development as an add-on that's sown into the C++ 5.0 integrated development environment (IDE).

In fact, working with a Java project in the IDE is identical in process to working with a C++ project. The IDE recognizes a project as Java-related, makes the editor Java-aware with appropriate syntax highlighting, and unleashes the Java compiler at build time.

Debugger integration shows a few seams, however. Getting at the Java debugger requires some nonintuitive right mouse-clicks rather than a toolbar selection. On the plus side, the debugger is visual and multipaned, a godsend in comparison to the command-line Java debugger that we've seen elsewhere. Borland's Java AppAccelerator speeds Java code execution by selectively compiling methods into native machine code (see the Technology Focus box on page 160).



```
Integer Rational::num
Integer Rational::den
void normalize()
Rational *Rational()
Rational *Rational(double)
Rational *Rational(long,long)
Rational *Rational(const Integer &
Rational *Rational(const Integer &
Rational *Rational(const Rational
void ~Rational()
```

```
Thread stopped
Thread stopped
Thread stopped
Thread stopped
 file line sp
n't convert '
nning
read stopped
read stopped
read stopped
read stopped
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The Development Suite version of BC++ 5.0 is so brimming with bundled products that we now understand why God made CD-ROMs.

Inclusion of database development tools is a trend we noticed in the last C++ compiler roundup. BC++ 5.0 now comes with the Visual Database Tools, a group of components (data-access Visual Basic custom controls [VBXes]) that purport to provide all you need to create a database application without writing any code.

You develop controls "visually" with the dialogue editor. You populate a dialogue form with controls and access them via a properties sheet, as you do in Visual Basic. You can get at the controls programmatically via framework classes that Borland provides. Most important, the controls are built atop the COM architecture and support the `IDispatch` interface; this means you can manipulate them through any OLE automation controller.

RATINGS	
TECHNOLOGY	★★★★
IMPLEMENTATION	★★★★
PERFORMANCE	★★★★

Version control is important for large, multiprogrammer projects and probably even more so for code reuse. Microsoft Visual C++'s component gallery will probably acquire aspects of a version-control system (if it hasn't already). The Borland C++ Development Suite now bundles Intersolv's PVCS version manager and integrates it fairly well into the IDE's project paradigm. You can, for example, check an entire project into the PVCS archives, and PVCS manages the check-ins of the individual files.

There seems to be a movement afoot in the C++ development community to replace file-based editors with browser-based ones. Here, Borland has work to do. Specifically, the Borland product won't let you launch the browser until you've compiled the application (and you need debug information in the application before you can browse). Also, the Borland IDE can't browse a Java program.

Borland has always been good about keeping up with the latest ANSI standards. The company's inclusion of the

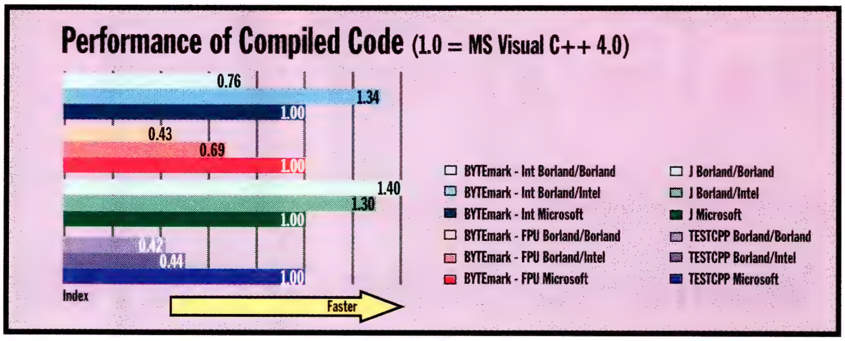
Standard Template Library as well as support for namespaces is an indication that Borland will continue to be near the forefront in standards support.

New, Not Just Improved

A major release, BC++ 5.0 provides a number of new features that we would not have predicted from past releases. ObjectScripting is the most significant addition to the IDE. Symantec's C++ IDE already sports a scripting language, but Borland's ObjectScripting provides wider control over the development environment.

ObjectScripting sits atop an object-oriented language called cScript, which is executed by the IDE script engine. The script engine understands objects that correspond to major components within the IDE. For example, the Editor object encapsulates properties and methods that let you access and modify edit buffers and other elements of the IDE's editor. This lets you automate the IDE. You can, for example, build a script that you turn loose on a subdirectory, and that script can gather all the source files within that subdirectory into a project for you, saving you the trouble of picking through all the files manually.

The Development Suite's CodeGuard error detection has capabilities that extend well beyond basic memory-leak detection. For example, it can identify resource errors (e.g., when your program attempts to perform a "Pen" operation on the object of a bit-map handle). CodeGuard has 16- and 32-bit personalities; the appropriate version comes into play depending on the target application. For the most part, the two have identical capabilities, although CodeGuard32 adds such features as support for multithreaded applications.



InstallShield Express, from InstallShield Corp., is yet another bundled package. In "wizard" fashion, it guides you through the process of constructing your installation in interview fashion. Most important—particularly if you develop for Windows 95—InstallShield can incorporate an uninstaller in your distribution.

If you've worked with earlier releases of the BC++ IDEs, you'll have no trouble here. BC++ 5.0 retains the same project paradigm as before, as well as the expandable-tree mechanism for accessing project and environment options. BC++ 5.0 includes two compiler back ends: one from Borland, the other from Intel. The Borland back end yields quicker compilation times, while the Intel back end produces swifter executables.

Performance Testing

We measured the BC++ 5.0 compiler's performance with three different tests, including the BYTEmark benchmarks and the J benchmarks used in our last roundup. We also included a benchmark based on the GNU C++ class library. Called TESTCPP, this benchmark exercises the libraries' string, rational, and integer packages. We ran BC++ 5.0 against Microsoft's Visual C++ 4.0, testing under Windows 95 on a 90-MHz Pentium Dell Dimension XPS90 using both products' 32-bit compilers.

The final scores are an index based on run times for the compiled code (see the figure). With its own back end, the Borland compiler did extremely well with the J benchmark test, while Visual C++ 4.0 showed superiority in the BYTEmark and TESTCPP benchmarks. We suspect that BC++ 5.0 does a better job of global optimization, while Visual C++ 4.0 excels in local optimizations. (The J application, being an interpreter, will flip back and forth between interpreting tasks and computing tasts; the BYTEmark and TESTCPP benchmarks consist of localized routines.)

It took a fix from Borland to produce a noncrashing executable with the Intel back end for the TESTCPP benchmark. The fix involved updating the command-line version of the Intel compiler. We also needed Borland's help to get a noncrashing J executable with the Intel back end. To CodeGuard's credit, it located a number of memory leaks in the J code, which we will be investigating.

A Decent Effort

With this top-notch compiler, Borland will continue to maintain high visibility in the C++ marketplace. The Development Suite is a complete applications development system—complete in that it even aids in the packaging of your deliverable. We cheer Borland's inclusion of ObjectScripting and look forward to the ObjectScript add-ons. And Borland planned to resolve the problems surrounding the Intel back end by the time you read this.

On the other hand, although we have no data other than our experience with earlier versions, the 5.0 IDE seems more sluggish overall. Confident that Borland will iron out the wrinkles, we give BC++ 5.0 two thumbs up. **B**

Rick Grehan is a senior technical editor for BYTE reviews. You can reach him by sending e-mail to **rick_g@bix.com**.

TECH FOCUS | **JAVA CODE**

Compiling Just in Time

Java executables are composed of bytecodes, which the Java virtual machine (VM) interprets to execute the program. Borland's Java VM execution engine incorporates AppAccelerator, a "just-in-time" compiler, to make Java programs run faster.

When a method is first called, the AppAccelerator compiles the bytecode to x86 machine language in the background and then "hooks" the original method entry point. Consequently, any subsequent time the method is called, you're running native machine code rather than interpreting bytecodes.

Does this do any good outside of the Borland development environment? Netscape recently announced that it's licensing AppAccelerator for inclusion in upcoming releases of its Navigator Web browser. Your browser might be using the Borland AppAccelerator even as you read this.

Review **Multimedia Authoring Tools**

Strata's MediaForge 2.0 gives you design tools and a full-fledged authoring environment. **By Stanford Diehl**

Forging a New Medium

The popularity of CD-ROMs and the explosive growth of the Web pose new challenges to presenting multimedia content in accessible, compelling ways. Strata MediaForge, a 32-bit authoring tool for Windows 95, rises to the challenge. (The software formerly was available only for the Mac.) Not just another fancy multimedia presentation tool, Media Forge is a powerful development environment for generating interactive titles, games, and multimedia Web sites.

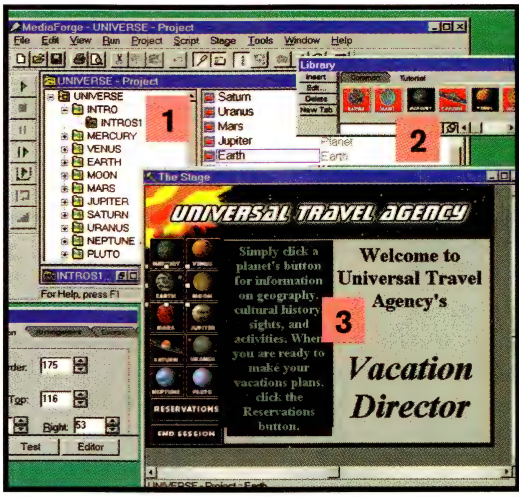
Hammer and Anvil

Without much trouble, nonprogrammers can use MediaForge to build multimedia titles complete with buttons, hotspots, video clips, multiple scenes, and formatted text. Savvy designers can even prototype titles by assembling media objects in the MediaForge List Editor. You build the title's basic design by dropping the media objects onto the Stage, a window that represents the final output screen. You place your objects on the Stage and arrange them as you want them to appear in the final title. From the Layout Palette, you can specify exact width and height measurements for an object as well as precise placement coordinates.

We sometimes found it confusing to work with layers in MediaForge. A title, for example, can contain up to 200 layers. Each object placed on the Stage gets a Z-Order, which represents the layer the object is on. This layering approach enables fine granularity as you develop complex titles with multiple overlapping objects, but there were times when we longed for simple layering controls such as Send to Back or Bring Forward.

Private Properties

Each object in a project is defined by a set of object properties. By double-clicking on objects on the Stage or in the List Editor, you launch a tabbed Object Properties dialog box. Here you can enrich the objects with color, bit-map images, path-based motion, and a wide assortment of special effects (e.g., wipes, fades, blinds, and curtains). From the Properties dialog you can also assign actions to a selected object by specifying what event (such as a left mouse button click) triggers the action and by selecting the action itself from a pull-down list. Through the options you pick in the property sheets, your objects become interactive.



Simply click a planet's button for information on geography, cultural history, sights, and activities. When you are ready to make your vacations plans, click the Reservations button.

Welcome to Universal Travel Agency's *Vacation Director*

MediaForge's authoring environment includes the Project view (1) for managing scenes and backgrounds and the Library Palette (2) for storing media objects you place later on the Stage (3).

MediaForge 2.0
for Windows 95
$1495

Strata Inc.
St. George, UT

(801) 628-5218
fax (801) 628-9756

http://www.strata3d.com

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RATINGS	
TECHNOLOGY	★ ★ ★ ★
IMPLEMENTATION	★ ★ ★ ★

The MediaForge toolbar lets you draw objects on the Stage or place new objects in the List Editor. The tools let you quickly customize rich text objects, load video files and select start and end frames, specify tracks from a music CD, or draw rectangles and other shapes. The hotspot tool creates transparent shapes that trigger actions when someone clicks on the area. You start with a diamond-shaped hotspot and four control points. By editing the shape with the existing control points, or by adding new control points for finer control, you can mold a hotspot into most any shape you need.

The Development Forge

For serious development, MediaForge combines powerful visual tools, utilities for creating custom dialog boxes and recording scripts, and an embedded programming language. The Data Entry tool creates forms on the Stage for accepting user input. The Properties dialog offers options for creating an input mask, specifying low and high validation values, and naming variables for storing the input.

You can quickly create Windows-style menus with the Menu Editor. From the Properties dialog, you simply type in the text you want to appear on the menu and associate these menu entries with actions. The Menu Editor can generate submenus, pull-down lists, and menu pop-ups. Unfortunately, a menu will not adjust its size to fit on the playback screen, so you'll need to keep that limitation in mind as you design menus.

Game developers will appreciate the Forge's sprite tools. Sprites are animated images that follow a predefined path or respond to directional input by the user. Sprites are challenging because they usually require multiple image frames to make the character's appearance match its direction of movement.

In addition to having a Sprite Import Wizard, MediaForge supports sprite configuration through a properties dialog. The dialog graphically displays eight directional movements. You can select each direction and associate a series of sprite frames to it. When the rendered sprite moves in a particular direction, the frames for that direction are activated. You can also designate a frame to display when no direction is chosen after a specified amount of time.

Beyond the Media Basics

For more stringent development needs, you can access the Forge's scripting language, MediaBasic, to process variables and strings, call subroutines and external scripts, and control the MediaForge environment programmatically. The MediaBasic Script Recorder tracks the actions and events you perform while working with other Windows applications. The recorder then converts the recorded actions and events into MediaBasic code. You can then incorporate these generated scripts into your application to control external programs or the Windows 95 interface. The MediaBasic Dialog Editor lets you generate custom dialog boxes for your scripts. You can visually design dialogs and specify push buttons, checkboxes, list boxes, combo boxes, text, and drop-downs. You can even capture a dialog box from an external application and edit it for your needs.

A DLL properties box lets you call procedures from DLLs. A drop-down list displays all the procedures available in the specified DLL and, from a second drop-down, you set parameters. MediaForge also supports OLE Custom Controls. You can create your own OLE control objects or incorporate third-party controls into your applications.

The program's 32-bit engine takes advantage of Windows 95's preemptive threading and the new memory model. When a script is launched, it automatically spawns its own thread. Other scripts and their associated objects can run simultaneously in multiple threads. You can control threads with commands such as Halt This Script's Thread.

Some OLE Controls may not work properly because of MediaForge's sophisticated use of threads. Many current OLE controls do not contain the threading model information required to properly handle multithreading. The documentation explains how to update the control's CLSID information with the Window's registry editor. You then include a REG file for each custom control that you ship with your application.

Strata plans to ship a Web player for MediaForge scripts, much like the Shockwave player for scripts created in Macromedia Director. It is a key architectural component in today's market, but it was not ready during our testing period.

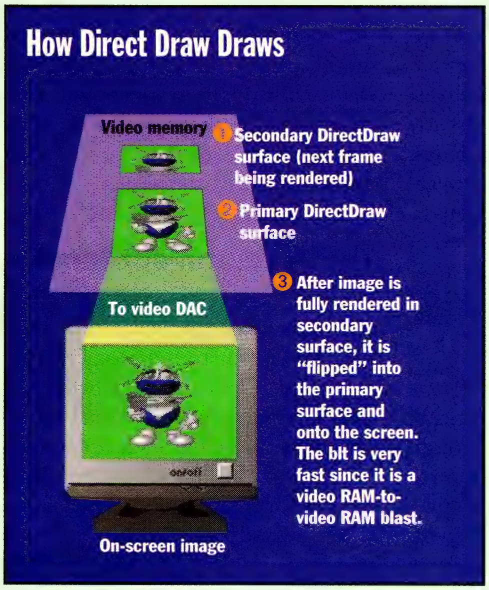
MediaForge taps the rich multimedia capabilities and 32-bit architecture of Windows 95. Sometimes the sheer complexity and flexibility can be intimidating, but Strata has done a commendable job of striking a balance between power and ease of use. MediaForge is a formidable authoring tool for the new-media generation. **B**

Formerly BYTE's director of product reviews, Stanford Diehl now works as a systems engineer for the Custom Print division of New England Business Service (Peterborough, NH). You can reach him at **sdiehl@bix.com**.

TECH FOCUS | WIN 95 GRAPHICS

Quenching a Thirst for Sprites

With Windows 3.1, the Graphical Device Interface (GDI) could not produce smooth, interactive sprites. You built images in the GDI and blted ("blitted") them from conventional memory to display memory, but this process could not support complex sprites. Enter DirectDraw, the graphical architecture of Windows 95 that lets developers bypass the GDI and access video hardware through a hardware abstraction layer (HAL). You first create a DirectDraw object for your application (using the DirectDrawCreate API) and then configure a primary and secondary surface of video memory with the CreateSurface method. You also need to build your palette with the CreatePalette call, but since DirectDraw can, in effect, take over the Windows environment, you don't have to share the 256 palette colors with other applications. You apply the full palette to the primary video surface and forget about it.


How Direct Draw Draws
Video memory
① Secondary DirectDraw surface (next frame being rendered)
② Primary DirectDraw surface
③ After image is fully rendered in secondary surface, it is "flipped" into the primary surface and onto the screen. The blt is very fast since it is a video RAM-to-video RAM blast.
To video DAC
on/off
On-screen image

DirectDraw speeds blts by working in video memory. After an image is rendered in the secondary DirectDraw surface, it is "flipped" onto the primary surface and onto the screen.

Developers must create a series of bit-mapped sprites to match the different poses of a character. To create a sprite, you reserve the video surface for it, specify the palette entry that represents your transparent color, then fill in the bits to draw your character.

DirectDraw performs warp-speed blts by working entirely in video memory. While your program is displaying one frame of graphics, the next frame is being rendered on the secondary surface. The secondary surface is then flipped onto the primary surface. The blts are occurring from video RAM to video RAM, bypassing the CPU and conventional memory. For even faster performance you can use the BltFast method, but you give up some features such as automatic clipping. Your sprites will now run and jump and mutilate legions of mutant space demons. Ah, sweet justice.

Jerry Pournelle

Pournelle

Comments on Code

Once nearly everyone did a little programming—then along came C

Most computer users don't write their own programs. Usually, that makes sense. Like books, computer programs are written by professionals, and most readers don't write their own novels. On the other hand, there are many more things we'd like our computers to do, if only we knew how to teach them. I've always said the real computer revolution will come when programming is like writing: while most people don't write novels, just about everyone can use a ballpoint pen to write a letter or keep a diary. We no longer depend on a literate elite to read and write our letters, and we shouldn't have to depend on an elite of programmers to make our computers do ordinary tasks specific to our needs.

I think C is a disaster. It will compile almost anything, including complete nonsense.

That was a lot more obvious when I began this column. In those days, nearly everyone interested in computers did a little programming, and much of this column was devoted to languages. It was a big deal when Turbo Pascal hit the market. When Philippe Kahn's Borland International brought out Turbo Basic, it shook Microsoft to the core. After years of neglect, they rapidly produced two major revisions to Microsoft Basic, and they haven't slowed much since.

In those days, computer literacy included at least an elementary understanding of programming, generally Pascal. The computer world wasn't divided into users and programmers; most of us were a little of each.

Then along came C.

I'm not sure why C took over so fast. It's a guru-friendly but user-hostile language that's difficult to learn. Unlike Pascal or BASIC, it requires near mastery before you can write useful programs. I think it went like this. In those days, our hardware wasn't very good. While C produced programs that were bulky compared to what you could do in assembly language, they were smaller and faster than Pascal and compiled BASIC programs, and enormously faster than interpreted languages.

Moreover, C code was portable, meaning that there were compilers for different CPU chips, so with luck you could compile programs to run on different hardware. That was very important before IBM set compatibility standards and ended much of the fragmentation in the non-Apple world. Today, all but a tiny fraction of the computer world is made up of two unequal parts, Intel/PC and Mac, and portability isn't so much of an issue. Almost all languages are portable within the two major communities, and neither C nor anything else is especially portable between them.

Meanwhile, our hardware has gotten a lot better, so that, for many applications, code size and program speed aren't as important as they used to be. Nowadays, we don't really need the special capabilities of C, but you'd never guess that. Today, being a "programmer" generally means the ability to use C and C++.

I think C is a disaster. It will compile almost anything, including complete nonsense, meaning that programmers must simulate the compiler in their heads and often don't catch mistakes until the program is nearly done. Forget that, though. The real problem with C and its derivatives is that using it is nearly a full-time job. With BASIC or Pascal, you can write some code, lay it aside for a while, and pick up where you left off without much lost time. With C and its derivatives, it takes more time than I have to understand what has been written, so there's rarely any time to add new code.

C is also painful to debug, because the compiler doesn't help you much. With Pascal, and to a lesser extent with BASIC, the tough job is getting a program to run at all; assuming you used a reasonably logical design, if you get it to run at all, it more or less does what you intended. Not so with C. It will run nearly anything; the problem is figuring out why it's doing something nobody would want a computer to do.

One of Pournelle's laws states that hardware solutions are generally better than software. The good news is that our hardware is now good enough that programs written in high-level languages will run fast enough despite the inefficiency. You don't need C to write useful programs. Sure, the latest real-time graphic actions for a space simulator may take professional skills; but languages like BASIC and Pascal are good enough to do some pretty amazing things, and with game design add-ons, Visual Basic (or VB) can produce quite professional games running at arcade speeds.

It amazes me how quickly you can produce complex working programs in BASIC, and with VB 4, you can give them a professional look. VB knows about Windows and toolbars and menus and that sort of thing. One of the big advantages of the Mac is that most programs work

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the same way, so that once you've learned the Mac conventions, you can sit down and do productive work with relatively unfamiliar software. VB lets you do much the same thing for Windows programs. I can say this with some authority because I've been doing some programming for both platforms.

A long time ago, I inherited an unfinished BASIC version of Roberta's whole-phonics reading program. I used QuickBasic to get a primitive DOS edition completed and out the door. A couple of years ago, she worked with another programmer to bring out a Mac version. The first DOS and Mac versions require an instructor, not necessarily a teacher, but someone to read what's on the screen. Both the PC and Mac versions work well, and they've been used to teach thousands of people of all ages to read English.

Alas, the DOS version was written to use ancient CGA graphics and thus looks clunky and out of date. I truthfully don't know of a better system for teaching reading, but for marketing purposes, the DOS version needs updating to a Windows version with better graphics. The Mac version is a bit more modern, but it too could use a face-lift.

Cosmetic improvements would help sales, and one of my goals is to use VB to make a pretty Windows version. Before we got to that, Roberta started a much more ambitious project: to create a standalone version that would teach people to read English without an instructor.

A couple of years ago, that would have been flat-out impossible on a PC. There wasn't good enough text-to-speech capability. In theory, we could have recorded each lesson as digital sound, but that would have taken at least one floppy disk for each lesson—and there are 70 lessons. Digital-sound files are big. It could be done on a CD-ROM, but we don't have the resources for building that.

I guarantee that I'll have an especially gruesome place in hell for programmers who write uncommented code.

The Mac was a different story. Apple is big in education, and the Mac world has always had superior sound capability. It only remained to choose a language and find a programmer. I was in the middle of a novel, so Roberta did that herself. The original notion was to do it in C++; but just then Apple brought out a text-to-speech capability that can be installed in the Mac OS and accessed with Allegiant Technologies' SuperCard, so that's what they chose. It took longer than she thought it would—programming always does—and before it was finished, she lost her programmer. That's where I came in.

What I inherited was a nearly complete but buggy SuperCard program that would take Roberta's scripts and present the lesson to the student. The basic program concept worked, but Roberta did a lot of experimenting, making improvements in the scripts and discovering that you can get dramatically different results depending on which voice you use to read the lessons. Some of her improvements didn't run in the code we had. She was anxious to get the program finished and out the door. I told her I'd look at it.

It turned out to be several thousand lines of uncommented SuperCard script.

Some years ago, Larry Niven and I wrote *Inferno*, an homage modernizing the great medieval work by Dante Alighieri. If we ever do a revision, I guarantee that I'll have an especially gruesome place in hell for programmers who write uncommented code. On the other hand, while we're unlikely to do an update of Dante's *Paradiso*, if we do, I'll give a special place to Allegiant Technologies. The excellent debugging features of SuperCard let me walk through the program commenting as I went, and in two weeks, I understood it well enough to go in and fix the bugs. We visited Allegiant Technologies in San Diego, and their people showed us some tricks for making things run faster with less memory. We particularly want to thank Richard Harper, their director of content development.

SuperCard is an odd language. For example, the only variable types are local (available in only one module of the program) and global. Otherwise, a variable can be a real number, an integer, a text string, a list, or an array. Indeed, the same variable can be each of those in turn if you're foolish enough to do that. SuperCard employs a lot of natural language. Suppose we have a variable named StudentText, consisting of a list of words separated by spaces. 'Get Item 3 of StudentText and Put it and ", " after NewText' will get the third word from the first list, append it to the second, and put a comma and a space after the word. You can then treat the first list as one big string, and if you change the delimiter to "," you can treat the second list as a list with items separated by commas.

This cavalier treatment of data structures is likely to drive professional programmers up a wall. On the other hand, it was possible for me to decipher page after page of uncommented code, insert diagnostic variables to help figure out what was going on, and write a hundred lines of SuperCard to fix the various bugs. I could never have done that with a C program, and I probably couldn't have done it with an uncommented BASIC program.

In other words, while SuperCard isn't truly self-documenting—you really should make comments as you go—it's a lot closer to that ideal than anything else I've seen so far. The result is an extremely useful tool for nonprogrammers who want to make their Mac do something interesting. You can work at your own pace and not spend all your time trying to remember what you did last. Teachers will find it valuable.

Like its predecessor, HyperCard, SuperCard is easy to learn; there's an excellent tutorial. Apple's HyperCard was a true breakthrough, an easily learned way to write Apple applications. Alas, Apple did not follow through, and SuperCard has pretty well displaced it as the language of choice for complex programs. Either one can get you started programming, though. The real limit is being afraid to start. SuperCard and the Mac are hands down the easiest way for nonprogrammers to write interesting programs.

There's nothing really comparable to SuperCard for PCs. VB comes closest, but it is a truly structured language, with real type checking: you can't arbitrarily use the same variable as a string, an array, and a number. The syntax is more "computer-like" than SuperCard, and writing VB programs is more like "real programming," particularly if you give some thought to data structures.

As Professor Niklaus Wirth of ETH—the Swiss equivalent of MIT—said long ago, data structures plus algorithms equals programs. Wirth wrote Pascal largely to demonstrate that; Pascal was designed more as a teaching aid than a practical language. Modula-2 and Oberon were the languages that Wirth intended for practical use. Either, in my judgment, would have been preferable to C—by a lot—but they didn't catch on, either for professional programmers or for the rest of us.

Instead, partly because Bill Gates got his start by writing Altair BASIC for the first microcomputer, in the U.S., BASIC became the language of choice outside professional programming circles. QuickBasic, and its successor VB, incorporate most of the best features of Pascal and Modula-2. VB has the vital ability to hide subroutine variables from the rest of the program (SuperCard also has that feature). Because it's tailored for and takes advantage of the Windows environment, you can build complicated screens and intricate control structures (e.g., menus, buttons, messages, and live areas on graphic screens) without writing any code at all; and given the new hardware, you can write astonishingly powerful programs that run quite well.

Moreover, there are a great number of third-party tools and add-ons, with more coming all the time. You can get tools for graphing, scientific calculations, and communications. You can add a database or a word processor to your application—even speech recognition. Once you know how to use VB, it's relatively simple to add these capabilities. Alas, I still haven't found a text-to-speech VB add-on that comes close to what the Mac can do.

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I spent the day doing some serious archiving. Over the years, I have had over a hundred computers. While I have used some formal backup systems, my real archive system is just to copy everything from the old machine to the new, network the old, and copy stuff back and forth; what might be called the maximum redundancy system. It's also a system of maximum confusion, since I don't really have any record of what's where.

It works so long as I keep adding disk space, but recently I found I was running out of space on Pentafluge, the Pentium 60 I do most of my work on, despite its 1 GB. The remedy for this is obvious: I can take many DOS programs like Q&A Write that don't need to access the disk after loading and put them onto a networked machine, like Little Cheetah, the ancient Cheetah 25-MHz 386/387 that has been running since 1988 and is being used as an archive server. That will free up lots of local space. I use Q&A Write all the time, so it loads once on start-up and never gets closed.

I've got a whole bunch of other programs I seldom use but don't want to get rid of, and they can all go onto a networked machine. The only problem was that the networked machines were all full. There are multiple copies of nearly everything I ever wrote and every game I ever played. Today, I finally decided to do something about it.

I have an embarrassment of tools for archiving. There's the HP Colorado Memory Systems T1000 tape drive that uses Travan 400-MB cartridges. There's the Datasonix Pereos tape drive that puts a gigabyte onto a cassette about the size of a postage stamp, and, no, I'm not kidding. It works, too. There's the Iomega Zip/Z100P drive. Those all work off the parallel port and are a lead-pipe cinch to install and use.

There's the Fujitsu DynaMO 230 magneto-optical (MO) drive. Finally, there's the Maxoptix T3-1300 optical drive. Those are both SCSI and thus slightly harder to install, but they're faster. In the end, I used the T3-1300 because it holds half a gigabyte per side, the medium is very stable and archives will last a long time, and the system has been installed for some time.

If I hadn't had the T3-1300, I'd have used the Zip/Z100P. It's not as fast as a SCSI drive, but even with automatic installation and not using the accelerator software that comes with the drive, it does a couple of megabytes a minute, and with Windows 95, it runs nicely in the background while I'm working on something else.

My real archive system is what might be called the maximum redundancy system.

Iomega did the Zip/Z100P right. It's inexpensive for both the drive and the medium; it works with almost any PC (not the Mac, alas). It installs simply and almost automatically; just connect to the parallel port, turn on the system, and run the software. It's well behaved, choosing the next-available drive letter rather than trying to replace an existing drive. Because it installs so simply, it's one of the best sneakernets imaginable, and because the medium is inexpensive, it's good for archives.

Those who need serious archiving capabilities are better off with the Maxoptix T3-1300. If you want something that is neat, and works as well as any tape system, the Datasonix Pereos is guaranteed to be a conversation starter. If you just want a low-cost, medium-performance backup-and-archive system, you should get an Iomega Zip/Z100P. You won't regret

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having one even if you have other stuff. It's highly recommended.

The CD-ROM of the month is Digital Humans. Imagine taking sections through a human body (two, actually, one of each sex), starting at the feet and going all the way to the head; photographing each section; and adding labels and comments. That's part of what's on this Windows CD-ROM. There's a lot more, including 3-D models and the tools to manipulate them. This is the best anatomy tool short of dissecting a corpse that I know of. Fair warning: they really did section human corpses. This isn't for the squeamish.

Meanwhile, the *American Medical Association Family Medical Guide* (Random House) has long been a standard home health reference book. It's now available on a CD-ROM from DK Multimedia. It's not fancy, mostly a book on a disc, but it's solid information in an easy-to-use format. The same company puts out other CD-ROMs, including Eyewitness Virtual Museum: Bird and Eyewitness Virtual Museum: Cat. These claim to be the ultimate multimedia guides to their subjects. That may be a bit overstated.

They really did section human corpses for Digital Humans. This isn't for the squeamish.

There isn't much multimedia to them. You walk through a museum and see the exhibits, such as a fresco of St. Francis preaching to the birds. The pictures are nice, but there's not much about any particular species. If you're really interested in birds, you'll do a lot better with a book. On the other hand, they can make a CD-ROM a lot cheaper than they can print a book, a CD-ROM takes up less room, and the indexing might be better than a book, although that's not true here.

This is the kind of product we saw a lot of in the early days of CD-ROM. I'd advise you to look at them before you buy them.

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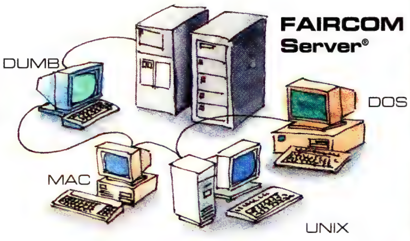

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I've been testing it with my horribly noisy lines, and so far the SupraSonic 288V+ is performing as well as my U.S. Robotics Courier. I haven't yet taken it to the Hotel Bellevue in Washington D.C., a place with I think the noisiest phone lines in the country, so I can't say it works as well as the Courier in all cases; but I'm impressed. I've always thought Diamond Multimedia Systems' Supra division built the most cost-effective modems around; the Diamond SupraSonic 288V+ is no exception. Recommended.

◆ ◆ ◆

Because I seldom write about stuff I haven't used a lot, I don't often have to apologize for a recommendation, but two of my recent game recommendations were premature. The reasons are instructive.

The two games are MicroProse Software's This Means War and Mindscape's Warhammer: Shadow of the Horned Rat. Both are the kind of game I like, tactical-strategic rather than arcade, with a story line and characterizations. Both can be a lot of fun to play. And both were programmed by people who clearly hate game players.

This Means War has two flaws: the game crashes often under Windows 95, something I can live with, and there's a random event called sabotage, which you can't turn off and can cost you the entire scenario in a second if what it randomly destroys is a crucial unit. When that happens, there's nothing for it but to dump the program and start from a saved position, and I've had that happen a dozen times in one scenario. I played to the end of the game despite all this.

Warhammer: Shadow of the Horned Rat is even worse. The user interface seems all right in early scenarios when you have few units, but after a while, you must control more than a dozen units. You move cavalry and infantry, target archers, designate spells for wizards—all in a "real time" that fights a full day's battle in 10 minutes, and this on a P-60; on the Gateway 2000 P5-133XL, it's far worse. Some units can get all the way across the board in under a minute. You can't slow the game down, and if you pause the game, you can't issue orders to your units. The result more resembles Whack-A-Mole than medieval fantasy war.

There are also some scenarios made hideously difficult because, for no discernible reason, your best troops run away rather than fight certain monsters. Moreover, if you go in with a disk editor and

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increase your troops' courage, skill, and initiative to ridiculously high levels, they *still* run away; it's as if the programmers were determined to show the player who is boss.

I fear I never finished Warhammer and thus must withdraw my recommendation. I did complete This Means War and it's fun, provided you're prepared to start over when the random-number generator goes insane with the sabotage. Both games, though, show what happens when programmers get the attitude that it's their job to defeat game players. Alas, that happens far more often than it should.

The game of the month is MicroProse Software's Civilization II. This is an improvement on Civilization rather than a fundamentally new game, the way Civilization was, but that's saying a lot. If you liked Civilization, you'll love this.

The other game of the month is Blizzard Entertainment's Warcraft: Orcs and Humans. This is a medieval fantasy game that started a number of trends. It's sort of Sim City with fire and sword, and it's a lot of fun. Then there's Warcraft II: Tides of Darkness, which adds ships, castles, cannons, and a whole bunch of new wrinkles to what was already a great game. Between them, they will probably cut U.S. productivity by about 5 percent....

The book of the month is Wendell Berry's *Another Turn of the Crank* (Counterpoint Press, 1995). Berry is a farmer, an agrarian, and a moralist, as well as a good writer. He has seen U.S. agriculture go from small farms to agribusiness and farming converted into an industrial activity in the name of cheap food. He doesn't like that, and his reasons are both disturbing and well worth thinking about.

The computer book of the month is *Windows 95 Answers* by Martin S. Matthews and Carole Boggs Matthews, one of Osborne McGraw-Hill's certified-technical-support series. It answers several hundred questions asked by people seeking technical support. Some were questions I had myself; others I didn't even know I needed to ask. I learned as much from this as from anything I have seen about Windows 95. Recommended.

The Web site of the month is the BYTE Site. Readers have complained that this column is shorter than it used to be. That's all true, and we're doing something about it. Starting this month,my regular column will be printed in BYTE, and you can find more on the BYTE Site (www.byte.com). Be sure to look it up.

Next month: I'll have more on high-end machines—and yes, I am finally going to get to the Intergraph; also networking and a huge pot full of new software. **B**

Jerry Pournelle is a science fiction writer and BYTE's senior contributing editor. You can write to Jerry c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please include a self-addressed, stamped envelope and put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at **jerryp@bix.com.**

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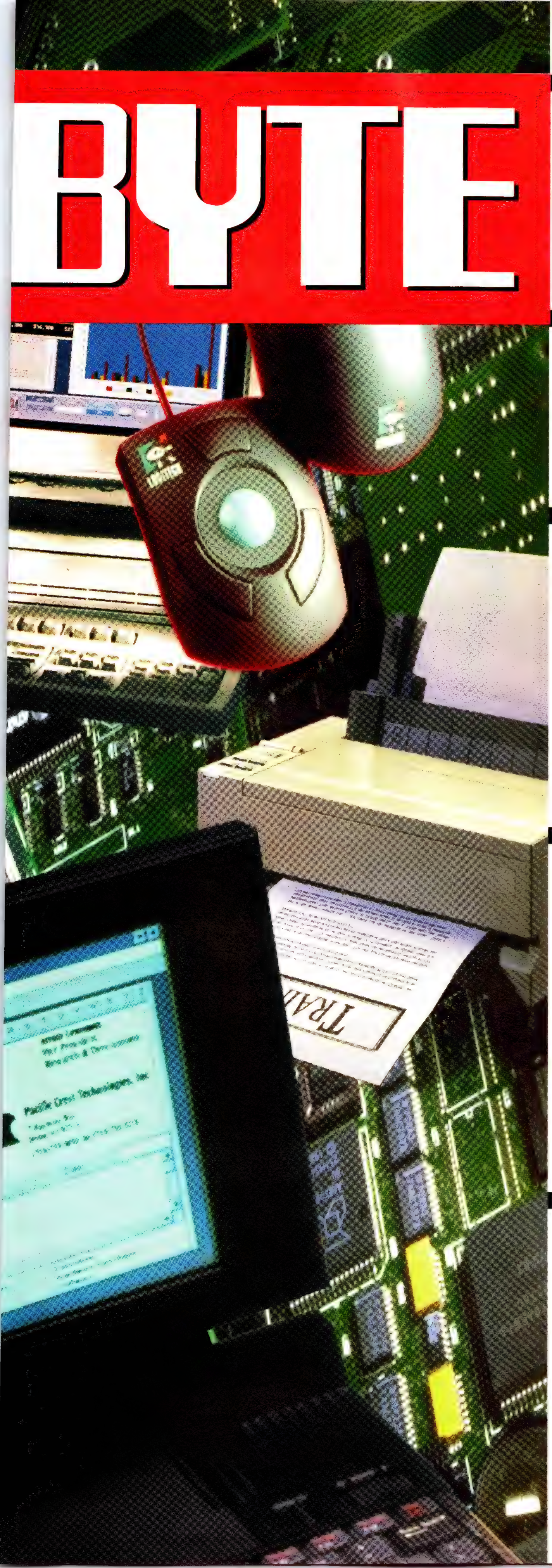

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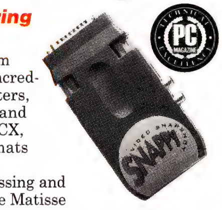

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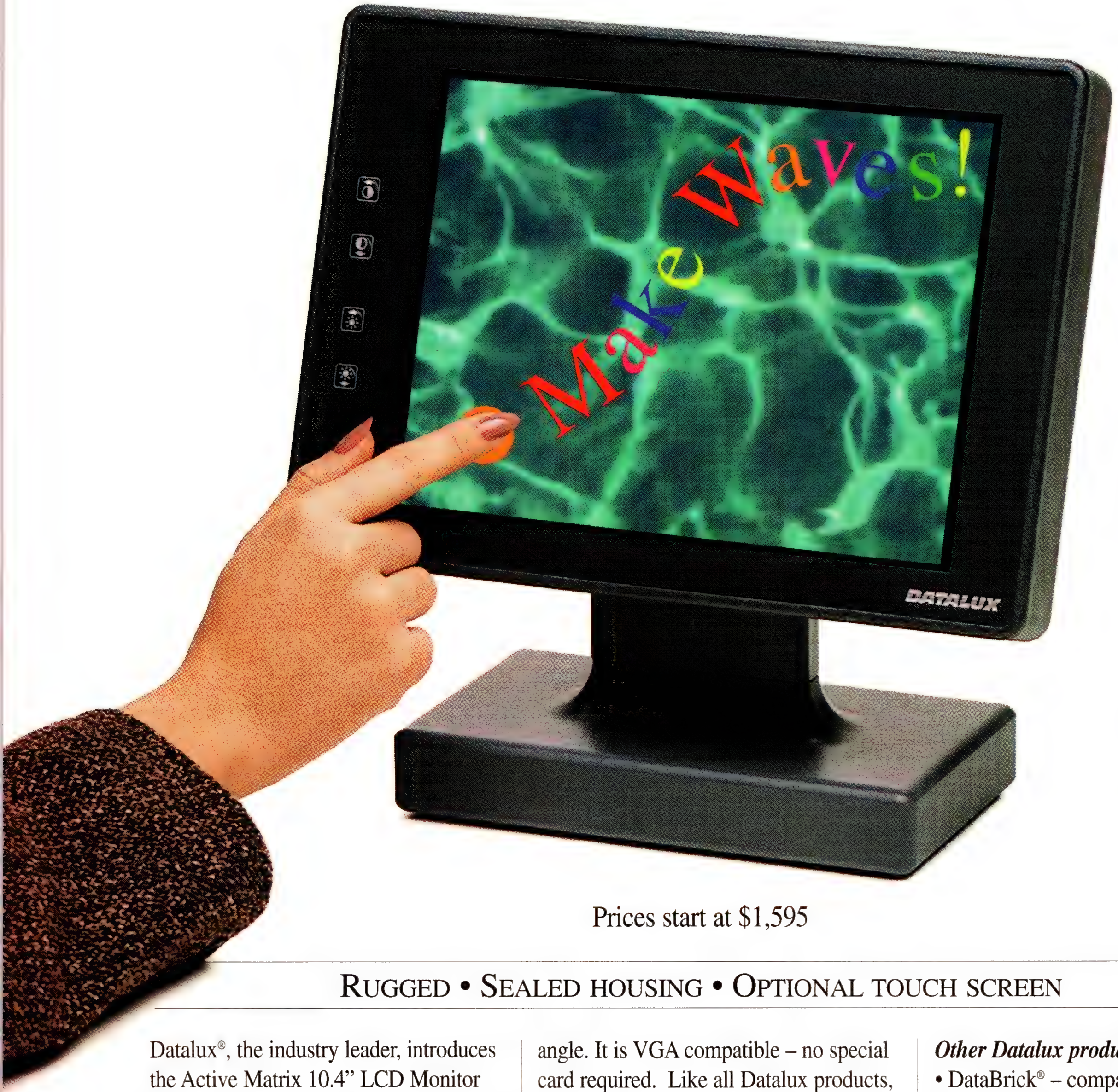

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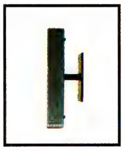

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NEW Dimension P75, P90

4MB	n/a	$59	8MB	n/a	$99
16MB	n/a	$279	32MB	n/a	$499

NEW Dimension P100+, P75+

4MB	(EDO) n/a	$69	8MB	(EDO) n/a	$149
16MB	(EDO) n/a	$279	32MB	(EDO) n/a	$499

NEW Dimension XPS (all models)

4MB	n/a	$69	4MB	(EDO) n/a	$69
8MB	n/a	$99	8MB	(EDO) n/a	$149
16MB	n/a	$269	16MB	(EDO) n/a	$279
32MB	n/a	$469	32MB	(EDO) n/a	$499

GATEWAY 2000

NEW PS-166XL, P5-166, P5-150, P5-133, P5-120, P5-75, P5-75 Family PC, P5-100 Fam. PC, P5-120 Family PC, P5-133 Fam. PC

4MB$^{\text{EDO}}$	n/a	$69	8MB$^{\text{EDO}}$	n/a	$149
16MB$^{\text{EDO}}$	n/a	$279	32MB$^{\text{EDO}}$	n/a	$499

HEWLETT-PACKARD

NEW Vectra VE, VL3, VL2 66/100, XM3, XM2, M2

4MB	D2690A	$59	8MB	D2691A	$99
16MB	n/a	$269	32MB	n/a	$469

IBM

NEW PC 700 Series (all models) & Valuepoint Performance Series (all models)

4MB	n/a	$59	8MB	n/a	$99
16MB	n/a	$269	32MB	n/a	$469

NEW PC 300 Series (all models) Aptiva (all models)

4MB	n/a	$59	8MB	n/a	$99
16MB	n/a	$269	32MB	n/a	$469

Aptiva 300, 500 and 700 series

4MB	n/a	$59	16MB	n/a	$269

Eduquest 55

4MB	74G1299	$167

Eduquest 30 , 40 and 50 models

4MB	60G0896	$99	16MB	60G0898	$319

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2MB	92F9935	$49	4MB	92F9694	$89

Valuepoint Performance models

4MB	92G9201 or 73G3131	$69
8MB	92G7520 or 73G3132	$149

PS/1 Consultant, Essential, Expert models x43, x44, PS/Valuepoint all models except Cxx models

4MB	96F9290	$79	16MB	96F9291	$269

PS/1 Consultant, Essential, Expert models

16MB	96F9291	$269

PS/2 25/286, 30/286

2MB	30F5360	$79

PS/2 35SX; LS, 40SX, 50Z, 55SX; LS, 65SX; LS, 70, XStation

2MB	6450604	$79

PS/2 70-A21; A61; B21; B61, PS/Valuepoint Cxx models
PS/1 Consultant, Essential, Expert models

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PS/2 90 XP, 95 XP, P75 (pairs) 56, 57 (all models)
PS/1 Consultant, Essential, Expert models, PS/1 Pro M2123

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2MB	6450379	$79

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4MB	6451060	$159

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8MB$^{\text{EDO}}$	n/a	$14
16MB$^{\text{EDO}}$	n/a	$27
32MB$^{\text{EDO}}$	n/a	$49

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16MB	OP-410-30002	$279	32MB	OP-410-30002	$99

PowerMate Value Series (all models) & Ready Series (all model

4MB	OP-410-14003	$59	8MB	OP-410-14004	$9
16MB	OP-410-14005	$269	32MB	OP-410-14006	$46

Image 425, 433, 466

4MB	410-12002	$59	16MB	410-12003	$26

Ready 425, 433

4MB	n/a	$59	16MB	n/a	$26

PowerMate 386/33i; Express Te, e models

4MB	OP410-6205	$69	16MB	OP410-6206	$27

PACKARD BELL

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16MB	n/a	$269	32MB	n/a	$469

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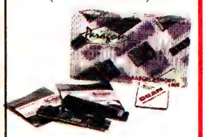

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	16MB	190598-001	$459
Contura 4/25, 4/33	4MB	144790-001	$125
	8MB	144790-002	$225
	16MB	144790-003	$459
NEW LTE Elite 4/40, 4/50, 4/75	4MB	199013-001	$125
	8MB	199015-001	$225
	16MB	199017-001	$579
Contura 400, 410, 420, 430	4MB	147653-001	$125
	8MB	147655-001	$225
	16MB	147657-001	$619
Elite 5000 PRICE DROP!	8MB	213515-001	$225
	16MB	213515-002	$459
	32MB	213515-003	$999
	64MB	213515-004	$2,089

DELL

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Latitude XPi, P75, P90	8MB	310-3435	$259
	16MB	310-3436	$579

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Model	MB	Part No.	Price
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	8MB	84G5692	$225
	16MB	84G5995	$459
ThinkPad 365, 365CD	4MB	92G7287	$151
	16MB	92G7293	$599
NEW ThinkPad 701	4MB	04H6193	$109
	8MB	04H6194	$225
	16MB	04H6195	$459
ThinkPad 700, 720	4MB	07G1419	$125
	8MB	07G1420	$225
	16MB	07G1421	$579
ThinkPad 760, 760CD	8MB	92G7316	$322
	16MB	92G7316	$599

NEC

Model	MB	Part No.	Price
Versa S, Versa 2000	4MB	OP-410-1201	$125
Versa 2200 PRICE DROP!	8MB	OP-410-1202	$225
	16MB	OP-410-1203	$599
Versa V, M, P, 4000, 4050, 4080 PRICE DROP!	4MB	OP-410-4001	$125
	8MB	OP-410-4002	$225
	16MB	OP-410-4003	$459
	32MB	OP-410-4004	$999

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>
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	8MB	FR-PCP7M-AB	$265
	16MB	FR-PCP7M-AC	$579
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	8MB	FR-PCP8M-AB	$265
	16MB	FR-PCP8M-AC	$579

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	16MB	9803933-0001	$599
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	16MB	9804841-0001	$599
	32MB	9809811-0001	$1,139
TM5000, 5010, 5030, 5100, 5200 PRICE DROP!	8MB	9798816-0001	$303
	16MB	9798816-0002	$719
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	16MB	9793358	$759

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	16MB	NW2028U	$425
	24MB	NW2029U	$859
NEW T1900, T4600, T4700, T4800, T4850, T4900	4MB	PC-PA2012U	$140
	8MB	PC-PA2013U	$249
	16MB	PC-PA2014U	$599
PRICE DROP!	32MB	PC-PA2015U	$1,139
NEW T3400, T3600	4MB	PC-PA2019U	$141
	8MB	PC-PA2020U	$269
	16MB	PC-PA2023U	$549
T400, T405, T410, T415, T610 Portege, T100, T105	8MB	NW2031U	$279
	16MB	NW2032U	$459
	32MB	NW2034U	$829
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	16MB	501488-003	$459
Ascentia 900N, 910N	4MB	501392-001	$125
	8MB	501392-002	$225
	16MB	501392-003	$459
Ascentia 950N PRICE DROP!	8MB	501728-002	$289
	16MB	501728-003	$599
Ascentia J, P	n/a	n/a	Call

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1MB	C2024A	$48

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2MB	33475B	$79	4MB	33477B	$129

HP LaserJet II, IID

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1MB	C2063A	$48	2MB	C2064A	$89
4MB	C2065A	$99	8MB	C2066A	$199

HP LaserJet 4P, 4MP, Color LaserJet

2MB	C3131A	$50	4MB	C3132A	$55

HP DeskJet 500, 500C, 520, 520C, 550C, 560, 560C

256K	22707B	$40

HP DesignJet 5P, 5MP

4MB	C3132A	$55	8MB	C3133A	$209

NEW HP LaserJet 5, 5N, 5M, 5SI, 5SIMX, 5+5M Color

2MB	C3131A	$50	4MB	C3132A	$55
8MB	C3133A	$99	16MB	n/a	$209

Okidata OL400

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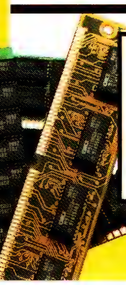

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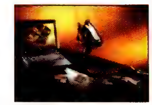

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1GB FAST-ATA2	$214	1.2GB FAST-ATA	$224
1.6GB FAST-ATA2	$311	2.1GB FAST-ATA	$333

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850MB FAST-ATA2	$186	1.2GB FAST-ATA2	$238
1.7GB FAST-ATA2	$267	2.6GB FAST-ATA2	$369

MICRO SOLUTIONS

BackPack 850MB connects to printer port	$383
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Model V1, 32-bit Vesa Extender Board for VLB	$79

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EIDE MAX, 16 bit ISA, no floppy	$49
EIDE 2300 Plus, VLB, with floppy	$69

ADAPTEC

AVA-1515 kit SCSI2 16bit no flop w/cable w/sw lite	$85
AHA-1520a SCSI2 16bit noflop wo/cable dos	$69
AHA-1540cf SCSI2 16bit noflop wo/cable dos	$193
AHA-2842a kit FASTSCSI2 VLB 2flop w/cable	$241
AHA-2940 FASTSCSI2 PCI no flp wo/cbl wo/sw	$217

NOTEBOOKS

AST

Ascentia J10, Pentium/75, 8MB, 10.4" DS, 500MB	$2,119
Ascentia J10, Pentium/75, 8MB, 10.4" DS, 800MB	$2,311
Ascentia J30, Pentium/100, 8MB, 10.4" DS, 800MB	$2,599
Ascentia J30, Pentium/100, 8MB, 10.4" Active, 800MB	$2,799
Ascentia J50, Pentium/133, 8MB, 10.4" Active, 800MB	$3,255
Ascentia P*, Pentium/100, 8MB, 11.3" DS, 800MB	$3,255
Ascentia P*, Pentium/100, 8MB, 11.3" DS, 1.2GB	$3,719
Ascentia P*, Pentium/133, 8MB, 11.3" Active, 800MB	$4,185
Ascentia P*, Pentium/133, 8MB, 11.3" Active, 1.2GB	$4,649

* Includes Internal 4X CD-ROM Drive

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T100CS, Pentium/75, 8MB, 10.4" DS, 520MB	$1,936
T410CS, Pentium/90, 8MB EDO, 11.3"DS, 810MB	$3,099
T410CDT, Pentium/90, 8MB EDO, 11.3" Active, 810MB, CD-ROM	$4,261
T610CT, Pentium/90, 8MB EDO, 9.5"Active, 720MB	$3,099
Tecra 700CS, Pentium/120, 8MB EDO, 11.3" DS, 1.26GB	$3,874
Tecra 700CDT, Pentium/120, 16MB EDO, 11.3"Active, 1.26GB	$4,842
Tecra 710CDT, Pentium/133, 16MB EDO, 12.1"Active, 1.26GB	$5,714
Tecra 720CDT, Pentium/133, 16MB EDO, 12.1"Active, 1.26GB	$6,102

TEXAS INSTRUMENTS

Extensa 510, Pentium/100, 8MB EDO, 10.4" DS, 810MB	$2,247
Extensa 560CD*, Pentium/75, 8MB, 10.4" DS, 810MB	$2,443
Extensa 560CDT*, Pentium/75, 8MB, 10.4" Active, 1.2GB	$3,420
Extensa 570CD**, Pentium/100, 8MB, 11.3" DS, 810MB	$2,931
Extensa 570CDT**, Pentium/100, 8MB, 10.4" Active, 1.2GB	$3,909
TM5100, Pentium/90, 8MB, 10.4"Active, 1.2GB	$3,37
TM5200, Pentium/120, 8MB, 10.4"Active, 1.2GB	$3,909
TM5300, Pentium/133, 8MB, 11.3"Active, 1.2GB	$4,691

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NEC

Versa 2200C, Pentium/75, 8MB, 9.5" Active, 810MB	$2,278
Versa 4000C, Pentium/75, 8MB, 10.1"Active, 540MB	$3,618
Versa 4050C, Pentium/90, 8MB, 10.1"Active, 810MB	$4,142
Versa 4050HC, Pentium/90, 8MB, 10.4"Active, 810MB	$3,903
Versa 4080HC, Pentium/120, 8MB, 10.4" Active, 1GB	$4,189

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CreditCard Ethernet • 28.8 Modem, 10Base-T	$450

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Stylus Color IIs Inkjet	$207	Stylus 1000 Inkjet	$473
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Stylus 1500 Inkjet	$878	Stylus Clr Pro XL inkjet	$1,694

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Deskjet 340	$296	Deskjet 600c	$251
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Deskjet 680c	$313	Deskjet 855cxi	$484
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Sportster 28.8 Voice Int/Ext	$185/$213
Sportster VI 28.8 Int/Ext	$275/$194

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Elite 2864 28.8 ext, v.34 upg to isdn	$427
Elite 2864i-s/t isdn 128kbps 2-wire leased led	$541

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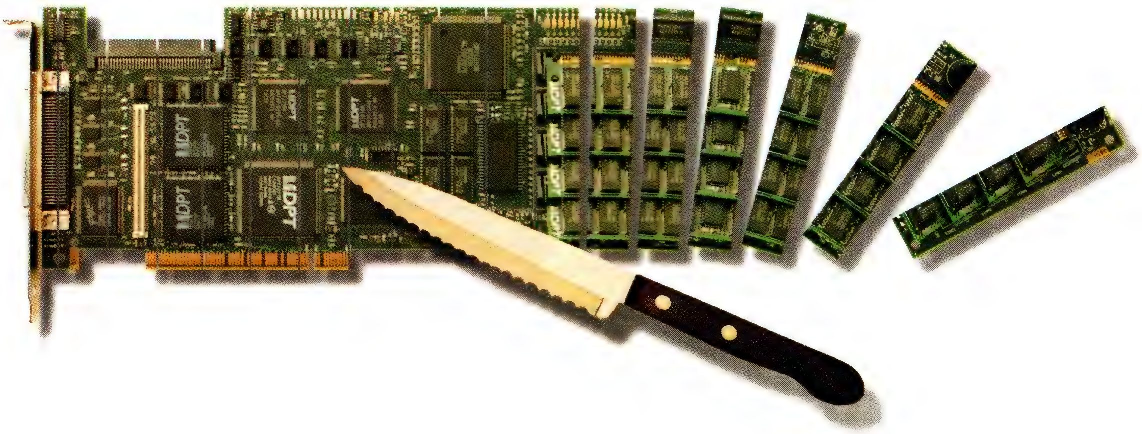

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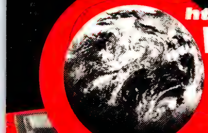

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	8Meg	500987-003	72 Pin	330
	16Meg	500987-004	72 Pin	619
	32Meg	500987-005	72 Pin	1399
Premmia LX P/60, MX4/66d, 4/100T, P/60	8Meg	500987-003	72 Pin	365
	16Meg	501340-002	72 Pin	620
	32Meg	500987-005	72 Pin	1325
	64Meg	501569-001	72 Pin	2595
Premmia 4133, 4133S, 4/50d, 4/66d	8Meg	501159-002		365
Premmia SE 4/33, 4/66d, P/60	16Meg	501159-003		620
Premmia MTE 4/33, 4/66d, P/60	32Meg	501159-004		1325
Manhattan G, V Series Server	64Meg	501159-005	72 Pin	2595
Power Premium 3/33, 4/33, 4/33S, 4/50d,4/66d Premium 486/25, 486/25E, 486/33, 486/33E Premium 386/33TE, 486/25TE, 33TE Prem. Serv., Prem II 386SX/20, 25	8Meg	500780-001	72 Pin	378
Prem. II 386/25, 386/33, 486/33, 486SX/20	8Meg	500780-001	64 Pin	398
Bravo 486/25, 486/33 Advantage 486/25, 486/33, 486/33P, 486 SX/20	2Meg Kit	500780-005	64 Pin	118
Premium SE 4/22	8 Meg Kit	500780-001	64 Pin	398
Premium SE 4/50, d, 66d, P/60	1Meg	500780-003	64 Pin	59
Prem.386/33T, 386 SX16, Prem. II 386SX/20, 386/25	4MB	500780-004	64 Pin	195
Premmia GX P/90, P/100	8Meg Kit/16Kit	501565-001/501566-001		378/699
	32Meg Kit/64 Meg Kit	501567-001/501568-001		958/2298

ZENITH MEMORY MODULES

MODEL	MEMORY	ZENITH PART#	PRICE
Z386/33, 25, 20, 33E	1Meg	ZA3800ME	$59
Z386/33, 25, 20, 33E, 486/25E	4Meg	ZA3800MK	180
Z386SX	2Meg	Z-605-1 KIT	119

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IBM PS/1, PS/2 MEMORY MODULES

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30F5360 (2Meg)	30-286, 25-286, 50 MTHR BD.	104
6450379 (2Meg)	80-111, 311-121, 321, 081, 161	84
6451060 (4Meg)	80-A21, A-61, 80-A31, 80-111, 80-311	189
6450604 (2Meg)	70-061, E61, 121, 50Z, 55SX, 65SX, P-70, 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	99
6450608 (2Meg)	70-A21, A-61, B-21, B-61, 35SX, 35LS, 40SX Val Pt.325T	90
34F2933 (4Meg)	35SX, 40SX, 55SX, 65SX, 55LS, 65LS	175
87F9977 (4Meg)	55SX, 55LS, 65SX, 40SX, 35SX, 35LS	175
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	109
92F9694 (4meg)	P/SI & P/S1/386SX, Model-2121	189
92G7200 (4Meg)	PSI Expert, Consultant, Willow	175
92G7201 (4Meg)	Value Point Performance, PC Server 4/66	175
92G7539 (4Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	189
92G7539 (8Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	380
92G7539 (16Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	650
92G7539 (32Meg)	Aptiva 310, 330, 350, 510, 530, 710, 730	1350
92G7203 (8Meg)	Value Point Performance, PC Server 4/66	339
92G7204 (16Meg)	Value Point Performance, PC Server 4/66	609
92G7205 (32Meg)	Value Point Performance, PC Server 4/66	1239
6450902 (2Meg)	56, 57, 57SX, 90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	90
6450128 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56,56SLC, P/S1 386SX, Mod-2123, 2133, 2155, Val Pt 77 486CS2, 486SX, 486DX2, SVR85,	175
6450129 (8Meg)	35SX, 40SX	339
6450130 (8Meg)	56, 57, 57SX, 90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	339
6451158 (4Meg ecc)	486, 95XP, 95A (install in pairs)	199
6451159 (8Meg ecc)	486, 95XP, 95A (install in pairs)	399
92G7209 (16Meg ecc)	9595 OPT	749

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IBM PART NO.	FOR MODEL NO.	PRICE
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07G1421 (8Meg)	Thinkpad 750, 750c, 755, 360, 355, 340,450	349
66G0095 (4 Meg)	Thinkpad 755, 360, 355, 340, 450	179
66G0094 (8Meg)	Thinkpad 755, 360, 355, 340, 450	349
66G0094 (16Meg)	Thinkpad 755, 360, 355, 340, 450	629
8189098 (4Meg)	Thinkpad 500, 510CS (3.3Volt)	209
8189099 (8Meg)	Thinkpad 500, 510CS (3.3Volt)	389
8189113 (16Meg)	Thinkpad 500, 510CS (3.3Volt)	869
79F0999 (2Meg)	LX40, N33SX, PS Note	103
79F1000 (4Meg)	LX40, N33SX, PS Note, Tkpd 350, 350c	189
79F1001 (8Meg)	LX40, N33SX, PS Note	349
4Meg/16Meg	Thinkpad 755 Dimm Modules	209/699
4Meg/16Meg w/Adap	Thinkpad 755	289/749
60G0378 (8Meg)	Thinkpad 350, 350c, PS Note 425	319
60G0379 (16Meg)	Thinkpad 350, 350c, PS Note 425	569
92F8804 (2Meg)	N45SL	109
92G7259 (4Meg)	Thinkpad 701C, CS, Butterfly	Call
92G7259 (8Meg)	Thinkpad 701C, CS, Butterfly	Call
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8Meg/16Meg	Thinkpad 820	390/729
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4Meg/8Meg/16Meg/32Meg	PC Pentium	179/339/629/12599

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MODEL	MEMORY	CMPQ PART#	PRICE
Elite 5000	8Meg/16Meg/32Meg/64 Meg		329/639/1249/2569
LTE/286	4Meg Bd	117081-003	$179
LTE/386S/20	4Meg Module	121125-002	209
LTE LITE/20, 25, 25C	4Meg Module	129769-002	209
LTE LITE/20, 25, 25C	8Meg Module	129769-003	389
LTE LITE/20, 25, 25C	16Meg Module	129769-004	769
LTE LITE 425C/33C/25E/25L	4Meg Module	142337-002	189
LTE LITE 425C/33C/25E/25L	8Meg Module	142337-003	329
LTE LITE 425C/33C/25E/25L	16Meg Module	142337-004	639
SLT/286	4Meg Module	110237-001	199
SLT/286	2Meg Module	118304-001	109
SLT/286	4Meg Module	118305-001	219
Concerto, LTE Elite	4Meg	144790-001	189
	8Meg	144790-002	369
	16Meg	144790-003	699
Contura 320, 325	2Meg	139497-001	99
	4Meg	139498-001	189
	8Meg	139499-001	339
Contura 400	4Meg/8Meg/16Meg		199/389/709
Contura 4/25, 4/25C, 4/25CX	4Meg	146520-001	189
	8Meg	146521-001	339
	16Meg	146531-001	699
Aero 4/25, 4/33L	4Meg	190532-001	184
	8Meg	190597-001	359

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MODEL	MEMORY	CMPQ PART#	PRICE
DeskPro 386/33, 386/33L	2Meg Module	115144-001	109
486/25, 486/33L	8Meg Module	116561-001	399
486/50L, System Pro	32Meg Module	116568-001	1399
DeskPro 386/25, 386/20	1Meg Module	113131-001	79
	4Meg Module	113132-001	199
DeskPro 386S-16MHz	1Meg Module	113633-001	149
	4Meg Module	113634-001	279
	1Meg Module	113646-001	79
	4Meg Module	112534-001	199
DeskPro 386/20E	1Meg Exp Bd	113644-001	149
DeskPro 386/25E	4Meg Exp Bd	113645-001	279
	1Meg Module	113131-001	79
	4Meg Module	113132-001	199
DeskPro 286N, 386N, 386SX20	1Meg Module	118688-001	59
all "M" series system LT series	2Meg Module	118689-001	89
all "I" series system LT series	4Meg Module	118690-001	169
	8Meg Module	128877-001	339

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DeskPro 5/60, 5/66M, 5/66M	8Meg Kit	149911-001	389
Prosignia 5/60	16Meg Kit	149949-001	699
Proliant 100 5/60	32Meg Kit	149912-001	1356
Proliant 2000 4/30, 5/66	64Meg Kit	149913-001	2516
Proliant 4000 4/50, 5/66	128Meg Kit	149914-001	5799
Prolinea 386 3/25S, 3/252S	2Meg Kit	141738-001	90
	8Meg Kit	141742-001	316
Prolinea 486, 4/25S, 4/33, 4/50, 4/66, CDS	2Meg Kit	141683-001	95
Enhanced Prolinea, Prosario series	4Meg Kit	141684-001	175
	8Meg Kit	141685-001	339
Prolinea PC Server, 486/33	8Meg Kit	141685-001	339
486 DX2/66	16Meg Kit	149320-001	599
	32Meg Kit	149147-001	1199

TOSHIBA LAPTOP MEMORY

MODEL	MEMORY	TOSHIBA PART#	PRICE
T2000/T2000SX	2Meg	PC-18-PA8317U	89
T2000SX/T1000LE	4Meg	PC-PA8314U	189
T2000SX/T1000LE	8Meg	PC14-PA8315U	389
T2000SXE/2200SX/T1800, 1850, C	2Meg	PC-PA2000U	89
T2000SXE/2200SX/T1800, 1850, C	4Meg	PC-PA2001U	189
T2000SXE/2200SX/T1800, 1850, C	8Meg	PC-PA2002U	359
T2100, 2105, 2150	4Meg/8Meg		199/389
T2100, 2105, 2150	16Meg/24Meg		729/1249
T4400SX, SXC, T6400, T6600	4Meg	PC-PA2004U	189
T4400SX, SXC, T6400, T6600	8Meg	PC-PA2005U	359
T4400SX, SXC, T6400, T6600	16Meg	PC-PA2010U	689
T4400, C, T4600, T4700, T1900, C, T190, T1950 (3.3v)	4Meg	PC-PA2012U	199
T4400, C, T4600, T4700, T1900, C, T190, T1950 (3.3v)	8Meg	PC-PA2013U	389
T4400, C, T4600, T4700, T1900, C, T190, T1950 (3.3v)	16Meg	PC-PA2014U	769
T3300SL	6Meg	PC-PA2008U	268
T3300SL	16Meg	PC-PA2009U	699
T3400CT, T2400, T3600	4Meg	PC-PA2019U	194
T3400CT, T2400, T3600	8Meg	PC-PA2020U	359
T3400CT, T2400, T3600	16Meg	PC-PA2021U	707
T3400CT	32Meg		1549
T3100e	2Meg	PC9-PA8340U	109
T3100SX	2Meg	PC-15PA8308U	109
T3100SX	4Meg	PC-15PA8310U	189
T3200	3Meg	PC6-PA7137U	185
T3200SX	2Meg	PC-12PA8308U	119
T3200SX	4Meg	PC-12PA8909	199
T3200SXC	2Meg	PC-19PA8318U	119
T3200SXC	4Meg	PC-15PA8319U	199
T5100	2Meg	PC7-PA8301U	95
T5200/T8500	2Meg	PC10-PA8304U	114
T5200/T8500	8Meg	PC10-PA8313U	419
T600, 610, CT	8 Meg/16 Meg/32Meg		439/879/1759
T700	8 Meg/16 Meg/32Meg		579/1159/2318
T400CS, 400CDT	8 Meg/16 Meg/32Meg		439/879/1759

NOTEBOOK, LAPTOP MEMORY

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ACER 730, 735C, 760, 780	2Meg/4Meg/8Meg		109/209/399
ACER 750	4Meg/8Meg/16Meg		199/459/799
AST Ascentia 900N, 800N	4Meg/8Meg/16Meg		199/379649
AST Bravo & Explorer	4Meg/16Meg	501255-001,-002	189/679
AST Notebook Prem Exed 386SX/20/25/25L	4Meg	500814-003	189
AST Power Exec 3/25C 435EL, 425SL	4Meg/16Meg	501166-001,-002	199/699
AST Power Exec 4/33SL	4Meg/16Meg	501318-001,002	194/769
AT&T Safan NSX/20	4Meg		259
Canon Innova Book 150	4Meg/16Meg		199/769
Canon Innova 486	2Meg/4Meg/8Meg		109/209/449
Canon Innova 486-10	4Meg/16Meg		189/449
Canon Notejet 486	4Meg/8Meg		199/389
DEC HiNOTE	4Meg/8Meg/16Meg		199/379/669
Dell Lattitude M, MC, MCX	4Meg/8Meg/16Meg		219/449/719
Dell Lattitude XP, 475, 4100, 4100CX	4Meg/16Meg		199/649
Dell Lattitude 486, 425, 433C, 433C, 450 450CX	4Meg/16Meg		199/649
Epson Action Note 650, 650c	4Meg/8Meg/16Meg		199/689
Epson Action Note 700,700c, 700cx	4Meg/16Meg		299-899
Epson Action Note 4000, 4LC/25, 4LC/33, 4SLC/2-50	6Meg		329
Everex Tempo LX, LX20 Carrier	2Meg		109
HP Omnibook 300, 480, 425	2Meg/4Meg		129
HP Omnibook 530, 600	4Meg/8Meg/12Meg		229/439/769
HP Omnibook 4000	4Meg/8Meg/16Meg		199/379/649
Lexmark SE10	1 Meg/4Meg		179/349
NEC Ultralite Versa, E, V	4Meg/8Meg		185/359
NEC Ultralite Versa, E, V	16Meg/20Meg		739/919
NEC Versa S	4Meg/8Meg/16Meg		209/379/799
Packard Bell 386SX, 286	4Meg		199
Panasonic CF170, CF270, CF370	1Meg		59
Panasonic CF380, CF480	2Meg/4Meg/16Meg		119/199/309
Panasonic CF-VP21P, CF-580	4Meg/16Meg		219/819
Sanyo 17/18 NB	2Meg		109
Sharp 6781, 6881, 6785, 6700,6800, 6741	2Meg/4Meg		109/199
Sharp 8150, 8650, 8660, 7700, 7760	4Meg/16Meg		199/679
Sharp 8700 & 8900	4Meg/8Meg/16Meg		199/379/649
Sharp PC-6220	1Meg		79
TI Travelmate 2000	1Meg		79
TI Travelmate 3000	2Meg		84
TI 4000, TI4000E	4Meg/16Meg		199/750
TI 4000M	4Meg/16Meg		179/799
TI 5000, 5100	8Meg/16Meg		319/619
TI Extensa 450, 450T, 455, 455T	4Meg/8Meg/16Meg		179/319/629
Zenith Master Sport 386SX	2Meg	ZA-300-1	114
Zenith Master Sport SL, SLE 600, 620, 625NL	2Meg	ZA-4-4	119
Zenith Z-Note 325L, LC	2Meg/8Meg	ZA3250-4/5	129/419
Zenith Z-Note 425LN, LNC, LNP	4Meg/8Meg/16Meg		209/469/839
Zenith Z-Star 4/33	2Meg/8Meg		119/369

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Cannon LBP 430	—	—	69	—	—	—	189	—	—	—	—	—
Cannon LBP 860	—	—	—	99	—	—	179	—	—	349	669	1249
Cannon LBP4, 4Lite, 4plus	—	—	159	219	—	—	—	—	—	—	—	—
Epson 6000, Action Laser	—	—	—	139	—	—	229	—	—	—	—	—
Epson Action Laser 1100,1600	—	—	69	99	—	—	189	—	—	379	599	—
Epson Action Laser II	—	—	89	—	208	—	—	327	—	—	—	—
Epson 8000,1800, 4000, 4100, 4300	—	—	89	—	208	—	—	327	—	—	—	—
Epson 1000, 1500, 5000, 5200	—	—	—	119	—	—	238	—	—	—	—	—
HP 2, 2D–	—	—	—	109	—	—	189	—	—	—	—	—
HP 3, 3D, 3P, 2P, 2P+	—	—	—	109	—	—	189	—	—	—	—	—
HP 4, 4M, 4SI, 4SIMX, 4P, 4MP	—	—	—	89	—	—	169	—	—	349	—	—
HP4L	—	—	59	—	—	—	—	—	—	—	—	—
HP 3SI	—	—	69	—	—	—	169	—	—	349	—	—
HP 4SI	—	—	—	89	—	—	149	—	—	299	—	—
HP 5L	—	—	69	129	—	—	219	—	—	399	—	—
HP 5P	—	—	—	89	—	—	149	—	—	299	489	—
HP Design Jet 600, 650, 200	—	—	—	89	—	—	175	—	—	349	—	—
HP Deskjet 500,500C,510,550,560	—	55	—	—	—	—	—	—	—	—	—	—
HP Deskjet 1200C, 1200CP	—	—	—	89	—	—	175	—	—	349	—	—
HP Paintjet XL300	109	—	—	—	—	—	289	—	—	469	837	—
IBM Laser 4019, 4019E	—	—	—	—	—	169	—	—	—	—	—	—
IBM Laser 4029, 4037	—	—	—	—	—	—	169	—	—	—	—	—
IBM Laser 4039, 4079	—	—	—	99	—	—	169	—	—	350	—	—
Lexmark, Optra L, LX, R, RX	—	—	—	—	—	—	139	—	—	299	499	972
NEC 90, 290	—	—	—	139	—	—	—	—	—	—	—	—
NEC 95, 97	—	—	—	99	—	—	—	—	—	—	—	—
Oki 400	—	—	—	125	—	—	—	—	—	—	—	—
Oki 400E, 400EX, 410E, 410EX	—	—	135	189	—	—	—	—	—	—	—	—
Oki 830, 840	—	—	—	109	—	—	—	—	—	—	—	—
Packard Bell PB 9500	—	—	—	139	—	—	227	—	—	—	—	—
Packard Bell 9815	—	—	—	159	—	—	269	—	—	—	—	—
Panasonic 4420/4450I	—	—	—	129	—	—	229	—	—	—	—	—
Panasonic 4410/4430	—	—	—	126	—	—	195	—	—	—	—	—
Panasonic 4450	—	—	99	—	—	—	—	—	—	—	—	—
Panasonic 4400/5400	—	—	89	129	—	—	229	—	—	—	—	—
Panasonic 4440/5410	—	—	109	179	—	—	—	—	—	—	—	—
Sharp 9400, 9460, 9600, 9700E	—	—	89	149	—	—	249	—	—	—	—	—
Sharp 9500, E, H, 9700, H	—	—	109	—	—	—	279	—	—	—	—	—
TI XL/PS17/PS35	—	—	55	—	—	—	—	—	—	—	—	—
TI Microlaser Pro E, Powerpro 600	—	—	89	139	—	—	229	—	—	429	—	—
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1.2GB	12MS	SCSI	499
MICROCHANNEL CONTROLLER			
IDE	169	SCSI-2	179
IBM PS/2 INTERNAL DRIVE KITS 30-8086,30-286,25-8086, 25-286			
630MB		IDE	349
1.0GB		IDE	399

MICROPOLIS

FACTORY NEW-5 YEAR WARRANTY				INT-EXT
MC4221	2.05GB	8.5MS	SCSI-2	$599-749
MC4421	2.1GB	9MS	SCSI-2	550-675
MC1936	3.0GB	11MS	SCSI-2	750-999
MC3243	4.3GB	8MS	SCSI-2	919-1034
MC1991	9.1GB	10MS	SCSI-2	1899-2149
MC4221AV	2.05GB	8.5MS	SCSI-AV	679-804
MC3243AV	4.3GB	8.5MS	SCSI-AV	999-1149
MC1991AV	9.1GB	10MS	SCSI-AV	1999-2149

CONNER

FACTORY NEW-2 YEAR WARRANTY				INT-EXT
CFS541A	635MB	14MS	IDE	$175-325
CFS1081A	1.1GB	14MS	IDE	202-352
CFS635A	635MB	14MS	IDE	179-329
CFS850A	850MB	14MS	IDE	190-340
CFS1275A	1.3GB	14MS	IDE	217-346
CFS1621A	1.6MB	14MS	IDE	259-409
CFP2105S	2.1GB	9MS	SCSI-2	595-734
CFP4207S	4.2GB	9MS	SCSI-2	925-1064

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FACTORY NEW-5 YEAR WARRANTY				INT-EXT
M1614T	1.1GB	11MS	IDE	$195-345
M1638T	1.1GB	9.5MS	IDE	545-695
M1638S	2.2GB	10MS	SCSI	499-649
M2934S	4.3GB	10MS	SCSI	899-1024

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FACTORY NEW-5 YEAR WARRANTY				
2105W	2.1GB	8.5MS	5400RPM	$739
4207W	4.2GB	9MS	7200RPM	1231

Seagate

FACTORY NEW-5 YEAR WARRANTY				
ST31230W	1.0GB	9MS	3.5X1"	$536
ST32550W	2.1GB	8MS	3.5X1"	849
ST15230W	4.3GB	9MS	3.5X1"	1042
ST15150W	4.3GB	8MS	3.5"	1199
ST410800W	9.0GB	11MS	5.25"	2099

Quantum

FACTORY NEW-5 YEAR WARRANTY				
XP32150W	2.1GB	8MS	3.5X1"	$840
VP32210W	2.2GB	8.5MS	3.5X1"	718
GP3430W	4.3GB	8.6MS	3.5"	1079
XP34300W	4.3GB	8MS	3.5"	1199

MICROPOLIS

FACTORY NEW-5 YEAR WARRANTY				
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MC3243W	4.30GB	8.5MS	3.5	1069
MC1991W	9.10GB	10MS	FH	1999

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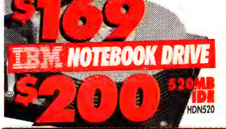
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PT60 2-4GB SCSI-2 DAT	994-1114

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Stealth 64 Video 2121TV, DRAM, 2MB EDO, PCI	305
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5401	4 Speed SCSI Int/Ext	134-359
3701	6.7 Speed SCSI Int/Ext	209-334

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USRobotics

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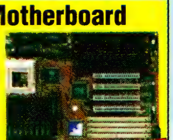

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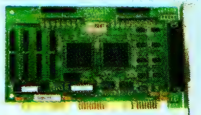

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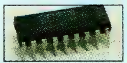

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41443	41256-80	16	256KB x 1 80ns	**2.19**
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53719	94000S-80	4MB x 9 80ns	**135.95**
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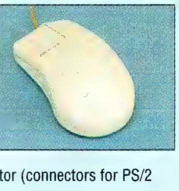

- Serial mouse
- PC/XT/AT/ 386/486/ PS/2 and compatibles
- Includes Microsoft® setup diskette and manual
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111860 2-button serial mouse..................**$39.95**

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Hawk Family

- Requires host SCSI-2 adapter
- Average seek, read/write: 9/10.5msec
- Speed: 5411RPM
- 512KB multisegmented cache buffer
- Mean time before failure (MTBF): 800,000 hours
- Power requirements: 6.3W (P/N130542); 6.5W (P/Ns 130551, 130569) 0.38A @ +12VDC ±5%; 0.70A @ +5VDC ±5%
- 3.5" low profile • One-year warranty

130542	Fast SCSI-2, 1.05GB	**$409.95**
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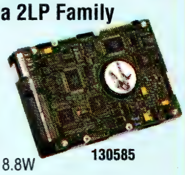

130585

- Requires host SCSI-2 adapter
- Average seek, read/write: 8/9msec
- Speed: 7200RPM
- 512KB multisegmented cache buffer
- Power requirements: 8.8W 0.49A @ +12VDC ±5%; 0.61A @ +5VDC ±5%
- 3.5" low profile • One-year warranty

130577	Fast SCSI-2, 2.1GB	**$849.95**
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Barracuda Family

- Requires host SCSI-2 adapter
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- Speed: 7200RPM
- 1024KB multisegmented cache buffer
- Mean time before failure (MTBF): 800,000 hours
- Power requirements: 12.5W 0.75A @ +12VDC ±5%; 0.65A @ +5VDC +5%
- 3.5" low profile • One-year warranty

130593 Fast & fast wide SCSI-2, 4.2GB....**$1249.95**

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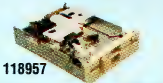

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118957	Panasonic 1.2 MB 5.25"	**$39.95**
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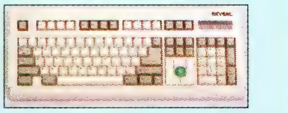
128813 Windows '95 keyboard..................**$19.95**

REVEAL 98-Key Keyboard with Trackball



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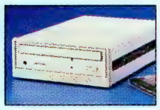

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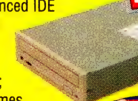

- Requires enhanced IDE controller card
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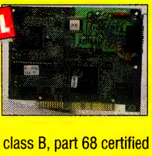

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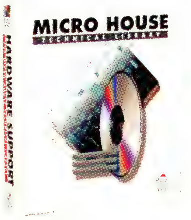

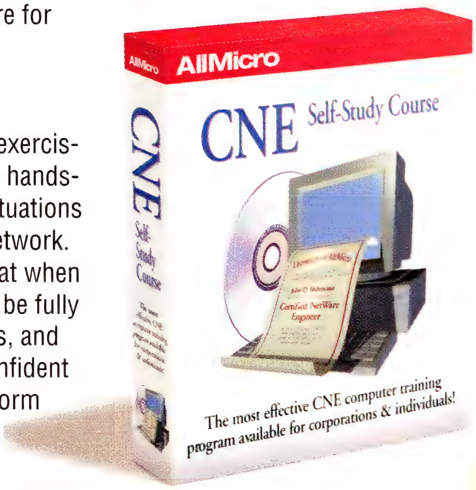
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256x8(SOJ)	–	19.00	18.00	–	–
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92G7205 (32Meg)	Value Point Performance, PC Server 4/66	689.00
6450902 (2Meg)	56, 57, 57SX.90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	69.00
6450128/92G7200 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56, 56SLC, P/S1, 386SX, Mod-2123, 2133, 2155, Val Pt 77, 486CS2, 486SX, SVR85 Value Point 77 486DX2, 486SX, SVR 85	86.00
6450129/92G7428 (8Meg)	35SX, 40SX	169.00
6450130/92G7202 (8Meg)	56, 57, 57SX, 90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	169.00
6451158/92G7208 (4Meg ecc)	486; 95XP; 95A (install in pairs)	109.00
6451159 (8Meg ecc)	486; 95XP; 95A (install in pairs)	219.00
92G7209/32G3720 (16Meg ecc)	9595 OPT	399.00

IBM NOTEBOOK & LAPTOP MEMORY

07G1415/07G1420 (4Meg)	Thinkpad 750, C, 700, C, 720, C, CL57SX	146.00
07G1416/07G1421 (8Meg)	Thinkpad 750, C, 700, C, 720, C, CL57SX	279.00
66G0095 (16Meg, 32Meg)	Thinkpad 750, C	488/976
66G0094 (4Meg)	Thinkpad 755, 360, 355, 340, 450	119.00
66G0094 (8Meg)	Thinkpad 755, 360, 355, 340, 450	219.00
66G0094 (16Meg, 32Meg)	***Thinkpad 755, 360, 355, 340, 450***	***439/1069***
4Meg/8Meg/16Meg	***Thinkpad 500***	***119/219/429***
8189098 (4Meg)	Thinkpad 500, 510CS (3.3 volt)	129.00
8189099 (8Meg, 16Meg)	Thinkpad 500, 510CS (3.3 volt)	249/489
79F0999 (2Meg)	LX40, N33SX, PS Note	69.00
79F1000 (4Meg)	LX40, N33SX, PS Note, Tkpd 350, 350c, PS Note 425	119.00
79F1001 (8Meg)	LX40, N33SX, PS Note	219.00
Hard Drive (810 Meg, 1.3 Gig)	Thinkpad 750, 755, 360, 355	719/797
(4Meg/16Meg)	Thinkpad 755 Dimm Modules	119/459
(4Meg/16 Meg w/Adap	Thinkpad 755	198/597
60G0378 (8Meg)	Thinkpad 350, 350c, PS Note 425	229.00
60G0379 (16Meg)	Thinkpad 350, 350c, PS Note 425	457.00
4Meg/8Meg/16Meg	***Thinkpad 360, 365***	***119/219/429***
4Meg/8Meg/16Meg/32Meg	***Thinkpad 700***	***146/279/488/976***
4Meg/8Meg/16Meg	***Thinkpad 701***	***109/209/419***
92G7259 (4Meg)	Thinkpad 701C, CS, Butterfly	109.00
92G7261 (8Meg)	Thinkpad 701C, CS, Butterfly	209.00
92G7263 (16Meg, 32Meg)	Thinkpad 701C, CS, Butterfly	419.00
4Meg/8Meg/16Meg (730T only)	Thinkpad 340, 730T	139/269/524/1586
(4Meg, 8Meg, 16Meg)	Thinkpad 760	119/239/449
8Meg/16Meg	Thinkpad 820	390/729
4Meg/8Meg/16Meg/32Meg	Thinkpad 850	193/399/719/1439
4Meg/8Meg/16Meg/32Meg	***Thinkpad 760***	***119/224/439/1469***
Hard Drive (810Meg)	***Thinkpad 760***	***529.00***

COMPAQ MEMORY MODULES

Deskpro 386S	1Meg Module/4Meg Module	79/129
	1Meg Board/4Meg Board	99/201
Deskpro 386 25E/20E	1Meg Module/4Meg Module	79/129
	1Meg Board/ 4 Meg Board	99/201
Deskpro 386/25, 20	1Meg Module/4Meg Module	79/129
Deskpro System Pro 386/33, 486/25, 486/50L	2/8/32Meg	91/244/854
Deskpro 4/66I, 4/33I, 4/25IS, 3?33I, 3/25I	2/4/8Meg	59/89/169
Deskpro "M" Series	Expansion Board 0K	119
Deskpro 450, 466, 4100, 575, 590, 5120, 5133	4/8/16/32Meg	89/169/369/689
Deskpro XE 433S, 450, 466	2/4/8Meg	69/109/209
Deskpro XE 560 (pairs)	4/8/16/32/64Meg	67/134/279/536/999
Deskpro XL450, 466, XL560, xl566, XL575, 5100 xl590	4/8/16/32/64Meg	67/134/279/536/999
Presario 433, CDS520, CDJV520, CDL524, CDS526, CDTV528 660, CDS660, CDS720, CDS724, CDS744, CDS860 CDS920, CDTV920, 924, CDS924, CDS954	4/8/16/32Meg	67/134/279/589
Presario 400 Series, 600 Series, 800 Series	4/8/16/32Meg	67/134/279/589
Presario CDS774, CDS972, CDS982, CDTV978, CDS974 (in pairs) CDS992, 7152, 7170, 7180, 9546, 9548, 9564	4/8/16/32Meg	67/134/279/589
Prolinea 4/25S, 4/33, 4/33S, 4/50, 4/66, CDS	1/2/4/8Meg	59/69/89/169
Prolinea MT 4/33S, 4/50, 4/66, Enhanced 4/33S, 4/50S, 4/50, 4/66	4/8/16/32 Meg	89/169/349/699
Prolinea 450, 466, 4100, 575, 590, 5120, 575, 590, 5120 575 mini, 5100 mini, 5133 mini	4/8/16/32Meg	89/169/349/699
Proliant 1500 5/75, 5/100, 1500R 5/75, 5100 (install in pairs)	4/8/16/32Meg	67/134/279/536
Prosignia 300, 575, 590, 500 5/90, 500 5/120 (install in pairs)	4/8/16/32Meg	67/134/279/536
Proliant 1000 5/60, Prosignia 5/60 (install in pairs)	8/16/32/64/128	134/279/536/999/2000
Proliant 2000 486/50, 5/66, 5/90, 2000R 5/66, 5/90 (install in pairs) 4000 486/50, 5/66, 5/90, 5/100, 4000R 5/66, 5/90, 5/100 4500 5/100, 4500R 5/100	8/16/32/64/128	134/279/536/999/2000

COMPAQ LAPTOPS & NOTEBOOKS

Compaq LTE 5000 Hard Drive	***810Meg, 1.3Gig***		***699/779***
Elite 5000, 5200	***8Meg/16Meg/32Meg/64Meg***		***219/419/762/1525***
LTE/386S/20	4Meg Module	121125-002	129.00
LTE LITE/20, 25, 25C	4Meg Module	129769-002	129.00
LTE LITE/20, 25, 25C	8Meg Module	129769-003	229.00
LTE LITE/20, 25, 25C	16Meg Module	129769-004	509.00
LTE LITE 425C/33C/25E/25L	4Meg Module	142337-002	134.00
LTE LITE 425C/33C/25E/25L	8Meg Module	142337-003	250.00
LTE LITE 425C/33C/25E/25L	16Meg Module	142337-004	460.00
SLT/386	4Meg Module	118305-001	129.00
Concerto, LTE Elite	4Meg	144790-001	119.00
	8Meg	144790-002	219.00
	16Meg	144790-003	429.00
Contura 320, 325	4Meg	139498-001	119.00
	8Meg	139499-001	219.00
Contura 400, 410, 420, 430	4Meg/8Meg/16Meg		119/211/437
Contura 4/25, 4/25C, 4/25CX	4Meg	146520-001	119.00
	8Meg	146521-001	229.00
	16Meg	146531-001	469.00
Aero 4/25. 4/33	4Meg	190532-001	109.00
	8Meg	190597-001	209.00

HARD DISK DRIVES

CONNER			MAXTOR			WESTERN DIGITAL		
850MB	CFS 850A	$213	1.0 GIG	7850 AV	$219	850MB	AC2850	$218
1.2 GIG	CFS 1275A	240	1.2 GIG	71260 AV	242	1.2 GIG	AC31200	240
1.6 GIG	—	287	1.6 GIG	—	285	1.6 GIG	AC31600	307
1060 SCSI		279						
2.1 SCSI		629						

PCMCIA VERSION 2.0

MODEL	PRICE	MODEL	PRICE
S-RAM Cards 1MEG	$119	Portable CD ROM (2x) & Card	$289
S-RAM Cards 2MEG	199	***SCSI Type II***	***119***
28.8/14.4 Data/Fax Modem	189	***Audio Card***	***149***
14,400/14,400 Data/Fax Modem	94	Multimedia Combo, Sound/SCSI	499
Readwriter Card (15A Slot)	149	Type III 260 Mg Hard Drive	419
Lan Ethernet (Coax), (10 Base T)	89	Type III 340 Mg Hard Drive	567
		Xircom Combo Ethernet + Modem II 28.8 Adapter	549

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TOSHIBA LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
Tecra 700 (SDRAM)	***8Meg/16Meg/32Meg***		***279/549/1099***
T2000SXE/2200SX/T1800, 1850, C	2Meg/4Meg/8Meg	PC-PA2000U	69/139/279
T2100, 2105, 2150, 2155, 2110, 2115	4Meg/8Meg/16Meg/24 Meg		107/259/449/671
T4400SX, SXC T6400, T6600	4Meg	PC-PA2004U	129.00
T4400SX, SXC T6400, T6600	8Meg	PC-PA2005U	229.00
T4400SX, SXC T6400, T6600	16Meg	PC-PA2010U	499.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	4Meg	PC-PA2012U	119.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	8Meg	PC-PA2013U	219.00
T4500, C, T4600, T4700, T1900, C, T1910, T1950 (3.3 v)	16Meg	PC-PA2014U	429.00
T4700, 4800, 4850 (Hard Drive)	810Meg/1.3 Gig		709/819
T3400CT, T2400, T3600	4Meg/8Meg/16Meg	PC-PA2019U	129/249/519
T600, 610, CT Edo	8Meg/16Meg/32Meg		219/489/957
T400CS, 400CDT, T100, 105 Edo	***8Meg/16Meg/32Meg***		***219/489/957***

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
ACER 730, 735C, 760, 780	2Meg/4Meg/8Meg		89/139/268
ACER 763, 765, 782, 784, 786, 787,	4Meg/8Meg/16Meg		119/219/439
ACER 750	4Meg/8Meg/16Meg		119/219/439
ACER Note Pro, ACER Note Lite	***4Meg/8Meg/16Meg***		***109/199/439***
ARM TS38	4Meg/8Meg/16Meg		119/219/439
AST Ascentia J10	***8Meg/16Meg/32Meg***		***199/359/695***
AST Ascentia 900N, 800N, 810, 910	4Meg/8Meg/16Meg		119/219/439
AST Ascentia 950	8Meg/16Meg		269/499
AST Bravo & Explorer	***4Meg/16Meg***	***501255-001, -002***	***109/439***
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	500814-003	109.00
AST Power Exec 3/25C, 425EL, 425SL	4Meg/16Meg	501166-001, -003	119/459
AST Power Exec 4/33SL	4Meg/16Meg	501318-001,002	139/479
AT&T Globalyst 130, 200 *(Call for other Globalyst)*	4Meg/8Meg/16Meg		119/219/439
AT&T Safari NSX/20	4Meg	PEC 37651	219.00
Austin DX4, DX2, SX2, SX Series	4Meg/16Meg		119/449
Bondwell B310, Plus	1Meg	23050-09100	59.00
Bondwell B310V, SX	4Meg		206
Canon Innova Book 150	4Meg/16Meg		119/467
Canon Innova Book 200LS	4Meg/8Meg/16Meg/24Meg		119/219/439/671
Canon Innova Book 350CD	***4Meg/8Meg/16Meg***		***139/229/499***
Canon Innova 486-10	4Meg/16Meg		119/489
Canon Notejet 486-25	4Meg/8Meg		139/289
Canon Notejet 486-33, 486C, 25 and 33	4Meg/8Meg		149/289
Canon Notejet 486c, 75, 100	8Meg/16Meg		219/499
Compuadd 450ns, 475ns	4Meg/16Meg		139/499
DEC HiNote, Ultra HiNote	4Meg/8Meg/16Meg		119/219/449
DEC HiNote VP	***8Meg/16Meg/32Meg***		***279/549/Call***
Dell Lattitude LX 4100C, MX, MC, M	4Meg/8Meg/16Meg		109/199/457
Dell Lattitude XPI	4Meg/8Meg/16Meg		109/199/457
Dell Lattitude XP, 475, 4100, 4100CX	4Meg/16Meg		129/449
Dell Latitude 486, 425, 433C, 433CX, 450, 450CX	4 Meg/16 Meg		129/449
DTK, DTN 4T 100P, 5P60	4Meg/16Meg/32Meg		229/469/919
Epson ActionNote 650, 650c, 660c, 660cx	4Meg/8Meg/16Meg		119/219/439
Epson ActionNote 700, 700c, 700cx	4Meg/16Meg		119/499
Epson ActionNote 800, 880, 866c	4Meg/8Meg/16Meg/20Meg		119/219/459/599
Epson ActionNote 890	***4Meg/8Meg/16Meg***		***119/229/499***
Epson ActionNote 4000 Notebook	6Meg		189
Epson ActionNote 4LC/25, 4LC/33, 4SLC/2-50	6Meg		189
Everex Tempo LX, LX20, Carrier	2Meg	PCA 00053-0001	89.00
Fujitsu NB5100	***8Meg/16Meg/32Meg***		***279/549/Call***
Gateway 2000 Colorbook 4/33	4Meg/16Meg		109/439
Gateway 2000 Nomad 425 DXL/SXL	4Meg/16Meg		170/759
Gateway 2000 486 Handbook or Liberty	4Meg/16Meg		119/459
Gateway 2000 Solo Series	8Meg/16Meg/32Meg		Call
HP Omnibook 300, 480, 425	2Meg/4Meg		83/129
HP Omnibook 530, 600	4Meg/8Meg/12Meg		119/229/419
HP Omnibook 4000	4Meg/8Meg/16Meg		119/229/499
HP Omnibook 5000	8Meg/16Meg/32Meg		229/499/999
Leading Edge Aviva 2000	4Meg/16Meg		119/459
Lexmark SE10	4Meg/8Meg		119/249
Magnavox Metalis	4Meg	286, 386SX	119
Midwest Micro Elite SX-25, SX33, DX2-50, DX2-66	4Meg/8Meg/16Meg		119/219/469
Midwest Micro Elite Sndbk SX33, DX3-50, DX4-75, DX4-100	4Meg/8Meg/16Meg		119/219/469
Midwest Micro Elite Sndbk Plus D5-75, D5-90	4Meg/8Meg/16Meg		119/219/469
M.tsuba Ninja II	4Meg/8Meg/16Meg		119/219/469
MPC Model 380	4Meg/8Meg/16Meg		119/219/469
NCR Safari 3180, 3181	4Meg/8Meg		119/229
NEC Ultralite Versa, E, V, MP	4 Meg/8Meg/16Meg/20Meg	OP4104	119/229/469/589
NEC Versa Removable Hard Drive	810Meg/1.3 Gig		509/779
NEC Versa S, Versa 2000C & 2000D	4Meg/8Meg/16Meg		119/219/469
NEC Versa 4000, 4050/4080	4/8/16/32Meg		119/219/469/799
Packard Bell 386SX, 286	4Meg	286, 386SX	119
Packard Bell Statesman	2Meg/8Meg		69/219
Panasonic CF170, CF270, CF370	1Meg	CF-BA165	49.00
Panasonic CF380, CF480	2Meg/4Meg/6Meg		79/119/179
Panasonic CF-V21P, CF-580	4Meg/16Meg		119/439
Panasonic CF-V41	4Meg/8Meg/16Meg/32Meg		119/219/449/999
Sanyo 17/18 NB	2Meg	MBC-NBMEM2	89.00
Sharp 6781, 6881, 6785, 6700, 6800, 6741	2Meg/4Meg		89/149
Sharp 8150, 8650, 8660, 7700, 7760	4Meg/16Meg		119/439
Sharp 8700, 8800, 8900	4Meg/8Meg/16Meg		109/219/439
Sharp 3010, 3020, 3050, 3060	4Meg/8Meg/16Meg		104/199/439
TI 4000, TI 4000E, TI 4000M	4Meg/16Meg		170/768
TI 5000, 5100	***8Meg/16Meg***		***274/549***
TI 6000	***8Meg/16Meg***		***219/399***
TI Extensa, 450, 450T, 455, 455T	4Meg/8Meg/16Meg		119/219/419
TI Extensa, 550, 555, 560, 565 (pairs)	***4Meg/8Meg/16Meg***		***119/219/419***
Tandy 1510, 2810, 3810	1Meg		59.00
Tandy 2820, 3820, 3830	2Meg/4Meg/6 Meg		79/119/179
Twinhead, Altima, Compudyne, 486SX, DX, Tandy 4860	4Meg/16Meg		119/499
Twinhead Slimnote 5	4Meg/8Meg/16Meg		129/249/499
Ultra 486 TS38	4Meg/8Meg/16Meg		129/249/499
Winbook XP	4Meg/16Meg		119/499
Zeos 386SX Notebook (not the + version)	2Meg		89.00
Zenith Master Sport 386SX	2Meg	ZA-300-1	99.00
Zenith Master Sport SL, SLE, 600, 620, 625NL	2Meg	ZA-4-4	89.00
Zenith Super Sport 286, 286E	1Meg	ZA-180-66	99.00
286E, SX	2Meg	ZA-180-64	89.00
SX Alpha/SX Beta	2Meg	ZA-180-86/ZA-180-87	89.00
Zenith Z-Note 425LN, LNC, LNP	4Meg		129.00
Zenith Z-Star 4/33	2Meg/8Meg		69/219
Zenith Z-Star EX	***4Meg/8Meg/16Meg***		***119/219/459***

LASER PRINTER MEMORY UPGRADES

AMOUNT UPGRADED	OK Bd	256k	1	2	3	3.5	4	5	6	8	16	32
Brother 630, 631, 641, 645	–	–	69	89	–	–	–	–	–	–	–	–
Canon LBP 430	–	–	39	–	–	–	89	–	–	–	–	–
Canon LBP 860, 1260	–	–	–	69	–	–	99	–	–	199	359	699
Canon LBP4, 4Lite, 4plus	–	–	129	179	–	–	–	–	–	–	–	–
Epson 6000, Action Laser	–	–	–	129	–	–	229	–	–	–	–	–
Epson Action Laser 1100, 1600	–	–	69	70	–	–	99	–	–	199	359	–
Epson Action Laser II	–	–	74	–	173	–	–	272	–	–	–	–
Epson 8000, 1800, 4000, 4100, 4300	–	–	89	–	173	–	–	272	–	–	–	–
Epson 1000,1500,5000,5200	–	–	–	89	–	–	178	–	–	–	–	–
HP 2, 2D–	–	–	–	79	–	–	119	–	–	–	–	–
HP 3, 3D, 3P, 2P 2P+	–	–	–	***79***	–	–	***119***	–	–	–	–	–
HP 4, 4M, 4SI, 4SIMX	–	–	–	59	–	–	89	–	–	169	–	–
HP 4P, 4PLUS, 4MPm 1600, 1600CM	–	–	19	39	–	–	67	–	–	134	–	–
HP 4L	–	–	59	–	–	–	–	–	–	–	–	–
HP 3SI	–	–	69	–	–	–	89	–	–	169	–	–
HP 5L	–	–	49	74	–	–	139	–	–	269	–	–
HP 5P, 5MP, 4V, 4MV	–	–	19	39	–	–	67	–	–	134	279	–
HP Design Jet 600, 650, 200	–	–	–	69	–	–	89	–	–	189	369	689
HP Deskjet 500, 500C, 510, 550,560	–	***34***	–	–	–	–	–	–	–	–	–	–
HP Deskjet 1200C, 1200C/P	–	–	–	69	–	–	89	–	–	129	–	–
HP Paintjet XL300	54	–	–	–	–	–	89	–	–	144	299	–
IBM Laser 4019, 4019E	–	–	–	–	–	139	–	–	–	–	–	–
IBM Laser 4029, 4037	–	–	–	–	–	–	129	–	–	–	–	–
IBM Laser 4039, 4079	–	–	–	***69***	–	–	***119***	–	–	***209***	–	–
Konica LP-3110, 3115	–	–	119	189	239	–	–	–	–	–	–	–
Lexmark Medley 4C, 4x, 4SX	–	–	Call	Call	Call	–	–	–	–	–	–	–
Lexmark, Optra L, LX, R, RX	–	–	–	–	–	–	67	–	–	134	279	689
Lexmark Valuwriter 300,600	–	–	59	69	–	–	129	–	–	–	–	–
Lexmark Winwriter 200, 400, 600	–	–	59	69	–	–	129	–	–	–	–	–
NEC 90, 290	–	–	–	89	–	–	–	–	–	–	–	–
NEC 95, 97	–	–	–	79	–	–	–	–	–	–	–	–
Oki 400	–	–	–	79	–	–	–	–	–	–	–	–
Oki 400E, 400EX, 410E, 410EX	–	–	89	109	169	–	189	–	–	–	–	–
Oki 830, 840	–	–	–	89	–	–	–	–	–	–	–	–
Oki 2350, 2450	–	–	Call	Call	–	–	–	–	–	–	–	–
Packard Bell PB 9500	–	–	–	139	–	–	227	–	–	–	–	–
Packard Bell 9815	–	–	–	139	–	–	229	–	–	–	–	–
Panasonic 4420/4450I	–	–	–	99	–	–	169	–	–	–	–	–
Panasonic 4410/4430	–	–	–	***99***	–	–	***159***	–	–	–	–	–
Panasonic 4450	–	–	89	–	–	–	–	–	–	–	–	–
Panasonic 4400/5400	–	–	89	99	–	–	189	–	–	–	–	–
Panasonic 4440, 5410, 6500	–	–	79	99	–	–	159	–	–	–	–	–
Sharp 9400, 9460, 9600, 9700E	–	–	69	99	–	–	189	–	–	–	–	–
Sharp 9500, E, H, 9700, H	–	–	79	–	–	–	259	–	–	–	–	–
TI XL/PS17/PS35	–	–	49	–	–	–	–	–	–	–	–	–
TI Microlaser Pro E, Powerpro, Pro 600	–	–	89	129	–	–	189	–	–	329	–	–
TI Microwriter	–	–	79	119	–	–	–	–	–	–	–	–

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73-66___-15	15 ft	6.44	5.85	5.37
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ST15230W	4.3GB	9MS	3.5X1"	1042
ST15150W	4.3GB	8MS	3.5"	1199
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512 X 36-2MB-80NS	50
1X36-4MB-70NS/60NS LOGIC	55
1X36-4MB-70NS/60NS MAJOR	66
2X36-8MB-70NS/60NS LOGIC	95
2X36-8MB-70NS/60NS MAJOR	115
4X36-16MB-70NS/60NS LOGIC	195
4X36-16MB-70NS/60NS MAJOR	225
8X36-32MB-70NS LOGIC	425
8X36-32MB-60NS LOGIC	425
8X36-32MB-70NS MAJOR	450
8X36-32MB-60NS MAJOR	450
16X36-64MB-70NS/60NS	1495
1 X 32-4MB-70NS/60NS	50
2 X 32-8MB-70NS/60NS	90
4 X 32-16MB-70NS/60NS	180
8 X 32-32MB-70NS/60NS	375
EDO MEMORY	
4MB/8MB EDO	55/110
16MB/32MB EDO	195/395
PIPELINE CACHE	
256K	25
512K	50

VIDEO BOARDS

DIAMOND MULTIMEDIA

SpeedstarStar 64 Graphics 2120, ISA, 1MB.	119
SpeedstarStar 64 Graphics 2220, ISA, 2MB.	175
Stealth 64 2120XL, DRAM, 1MB, PCI, VLB	149
Stealth 64 2220XL, DRAM, 2MB, PCI, VLB	159
Stealth 64 Video 2121, DRAM, 1MB, PCI	149
Stealth 64 Video 2201, DRAM, 2MB, PCI	199
Stealth 64 Video 2121TV, DRAM, 1MB, PCI	249
Stealth 64 Video 2121TV, DRAM, 2MB, PCI	305
Stealth 64 Video 3240XL, VRAM, 2MB, PCI	339
Stealth 64 Video 3240XL, VRAM, 2MB, VLB	329
Stealth 64 Video 3240XL, VRAM, 4MB, VLB, PCI	475
Edge 3D 2120XL, DRAM, 1MB, PCI	219
Edge 3D 3240XL, DRAM, 2MB, PCI	405

ATI

ATI SPECIAL VIDEO BOARD WINTURBO ISA, VRAM 2MB, 64 BIT. $199

ATI Graphics Xpression 2MB, ISA, VLB, PCI	$199
ATI WinTurbo VRAM 2MB ISA, VLB, PCI	245
Graphics Pro Turbo 2MB ISA, PCI	258
Graphics Pro Turbo 4MB ISA, VLB, PCI	399

BOCA RESEARCH INC

Voyager 1MB VL-Bus	$99
Voyager 2MB VL-Bus	165

#9GXE Number Nine Computer Corporation

9FX Vision 330 1MB DRAM, PCI	$139
9FX Vision 330 2MB DRAM, PCI	179
9FX Motion 531 1MB DRAM, PCI, VLB	179
9FX Motion 531 2MB DRAM, PCI, VLB	225
9FX Motion 771 2MB VRAM, PCI, VLB	295
9FX Motion 771 4MB VRAM, PCI, VLB	445
9GXE Pro 1600 2 MB VRAM, PCI, VLB	549
9GXE Pro 1600 4 MB VRAM, PCI, VLB	719
Imagine 128 4MB VRAM	599
Imagine 128 8MB VRAM	1299

TRIDENT-SVGA

SVGA 256K ISA	$38
SVGA 512K 1024 X 768 ISA	50
SVGA 1MB 1024 X 768 ISA	88
SVGA 1024 X 768 1MB VLB VGA card	98

IBM THINKPAD

2 1/2" REMOVABLE DRIVES

755, 355, 360, 750	
524MB	$795
710MB	$895
810MB	$995
1.2GB	$1395
700, 700C, 780, 720C	
340MB	$795
524MB	$895
720MB	$1395
701C, 701CS	
540MB	$795
720MB	$895

NEC VERSA E, M, V, P

2 1/2" REMOVABLE DRIVES

524MB	$795
810MB	$895
1.2GB	$1395

CD ROMS

NEC

NEC-SPECIAL 4X Speed SCSI-5PK EA $239

CDR2225 4 Speed, SCSI, Int/Ext	$134-305
CDR512I 6 Speed, SCSI, Int	239
CDR512 6 Speed, SCSI, Ext	389
Quad 7CD Changer (4Xc)	335

DIAMOND NEW

Ultra 8X • Super fast 8X CD ROM IDE . . $218

PLEXTOR

PX-43CE 4.5X, SCSI, Int, 256 Cache	$255
PX-45CE 4.5X, SCSI, Ext, 256 Cache	380
PX-63CS 6X, SCSI, Int/Ext 256 Cache	299-449
PX-83CS 6X, SCSI, Int/Ext 256 Cache	425-515

PIONEER

624X 6-CD Changer4.4 X, SCSI, Int/Ext	$299-449
1804X 18-Disc Chanager 4X, SCSI, Int	1815

SONY

SONY-SPECIAL 4X Speed SCSI-5PK EA $139

CDS-76 4X Int/Ext IDE	60-240
CDS-76S 4X Int/Ext SCSI	139-269

TEAC

CD-55A SuperQuad 4X AT Drive	$99-240
CD-56E Six Speed Int	119-269

TOSHIBA

5402B 4 Speed IDE Int/Ext	$64-214
5522 6 Speed IDE Int/Ext	109-259
5401 4 Speed SCSI Int/Ext	134-359
3701 6.7 Speed SCSI Int/Ext	209-334

MITSUMI

FX400 4 Speed Int/Ext IDE	$59-209
FX600 6 Speed Int/Ext IDE	104-254

SCSI-IDE CABLES

HARD DRIVE EXTERNAL CABLES	
CENTRONICS 50 TO SCSI-II	$50
CENTRONICS 50 TO MAC 25-PIN	25
CENTRONICS 50 TO CENTRONICS 50 6FT	25
CENTRONICS 50 TO CENTRONICS 50 3FT	20
CENTRONICS TO DB-50	50
DB-50 TO SCSI-II	50
DB-50 TO DB-50	50
SCSI-II TO SCSI-II	50
FAST WIDE TO CENTRONICS EXT	99
68 PIN WIDE TO WIDE 3FT EXT	99
HARD DRIVE INTERNAL CABLES	
SCSI 50-PIN RIBBON 2/3/4 DEVICE	$10-15-20
SCSI 50-PIN RIBBON 5/6/7 DEVICE	25-30-35
SCSI FAST 68-PIN WIDE 3 CONN.2 DEVICE	65
SCSI FAST 68-PIN WIDE 5 CONN.4 DEVICE	99
SCSI FAST 68-PIN WIDE 8 CONN.7 DEVICE	139
IDE 40-PIN RIBBON 3 CONNS	9
FLOPPY & IDE CABLES SET	11
PASSIVE TERMINATOR	20
ACTIVE TERMINATOR	50

MOTHERBOARDS

GIGABYTE GA-86ATE PENTIU

3 PCI Slots, One PCI/ISA Shared, 3 ISA Slots, Four 72 Pin SIMMS Sockets (Su
EDO SIMMS), Triton Chipset, Floppy Port, Two FIFO Serial Ports, One ECP/EPP
Parallel Port, Two IDE Interfaces (PIO Mode 3 & PIO Mode 4), Board Size: 10"x

75-$280/90-$375/100-$385/120-$429/133-$480/150-$595/166-

NEW! INTEL ATLANTIS PENTIU

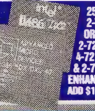
3 PCI, 2 ISA Shared, 1 PCI/ISA Slots, 256 Pipeline Burst Cache,4x72 Pin So
(up to 128MB),1MB Flash BIOS, Intel Triton Chipset, Integrated PCI/IDE, Interg
Super I/O, Integrated ATI Video Card, PC'95 Compiant w/Windows '95 Plug &

75-$469/90-$535/100-$545/120-$599/133-$685/150-$805/160-

INTEL ENDEAVOR PENTIU

3 PCI slots, 1 PCI/ISA Shared, 2 ISA Slots, four 72 Pin Simm slots (will support EDO RAM),
Pipelined Burst Cache On Board (Upgradable to 512K), built-in Creative Labs Vibra 16S Sou
(no need for a seporate sound card), Floppy Port, Two FIFO Serial Ports, One EPP/ECP Para
Two IDE Interfaces PIO Mode 3 & PIO Mode 4, Triton PCI Coast Chipset, board Size: 8.

75-$333/90-$358/100-$368/120-$425/133-$506/150-$621/166-



INTEL-AMD-486-PENTIUM		MOTHER-BOARD	MOTH BOA WIT CP
PENTIUM-75	256K CACHE, 3-PCI SLOTS, 3 ISA, 256 PIPELINE CACHE BURST, 1PCI-ISA SHARED FLASH BIOS, 4-72PIN, UP TO 128 RAM, ADD $10 FOR CPU FAN	$155	$24
PENTIUM-90		155	27
PENTIUM-100		155	28
PENTIUM-120		155	35
PENTIUM-133		155	42
PENTIUM-150	CALL FOR PRICES ON PENTIUM PRO MOTHERBOARDS & CPU'S	155	54
PENTIUM-166		155	69
INTEL-486DX2-66	256C VLB, 7-ISA, 2-VLB, 8-30 PIN OR 4-30 PIN & 2-72 PIN OR 4-72 PIN, 8-30 PIN & 2-72 PIN, ENHANCED BIOS, ADD $10 FOR CPU FAN	120	15
INTEL-486DX4-100		120	21
AMD-486DX2-66/DX4100		120	140-16
AMD-486DX4-120/133		120	175-19

PROCESSOR UPGRADES TURN A 386 INTO A 486 — **Cyrix $199** [illegible]

INTEL OverDrive® PROCESSORS

ODPR/ODP-66 $145	PENTIUM 63 $179
ODPR/ODP-75 $165	PENTIUM 83 $259
ODPR/ODP-100 $127	PENTIUM 133 $39

SCSI-IDE CONTROLLERS

adaptec

1505	CD ROM 16-Bit SCSI Kit	$47
1515	16 BitISA-SCSI 2 KIT	82
1520	16 BitISA-SCSI 2 (7 DEVICE CARD)	99
1522	16 Bit 7HD/2FD KIT	136
1522	16 Bit 7HD/2FD Card Only	119
1530PK	16 Bit ISA to FAST SCSI-II Kit	189
1542	Bus MasterCard Only	199
1542CPK	Bus Master Kit	255
1640K	MicroChannel for PS/2, 7HD	345
2940K	32-Bit PCI SCSI-2 Kit	275
2940WK	32-Bit PCI Wide Kit	284
2940UWK	32-Bit PCI Ultra Wide Kit	299
2742T	EISA KIT, 14HDs	349
2742W	FAST WIDE SCSI CARD	399
2825VL	Enhanced SCSI/IDE Kit	149
2842A	VL SCSI 2 VESA	259
1460	Slim SCSI PCMCIA SCCSI Card	199
3940	Dual Channel PCI Controller Kit	469
3940W	32 BIT WIDE PCI DUAL CHANNEL KIT	475
T160	16-Bit SCSI	85
T348	Parallel Port to SCSI Plus	149
T358	Parallel Port to SCSI Plus Enhanced	199

PROMISE TECHNOLOGY, INC.

IDE & SCSI CACHE CONTROLLERS		
DC200	2FD/4HD ISA (exp. to 16MB)	$99
DC2300+	Enhanced IDE VLB w/16550 i/o	69
5030	32-Bit PCI BusMaster IDE Caching	159
DC440	BusMaster SCSI/IDE VLB	179
DC540	BusMaster PCI SCSI WIDE	189

gsi

HI PERFORMANCE IDE CONTROLLERS		
11	8-Bit 4FD & 250MB Tape Accel Card	$5
18	Co-Exist, High Perf. IDE Card	5
21	2HD, 4FD (up to 2.88M)	6
32	8Multi-port IDE, Flpy, Tape, & I/O Accel	12

BUSLOGIC

KT445C	32-Bit VLB Fast SCSI-2 Kit	$1
KT545C	16-Bit ISA BusMaster Fast SCSI-2 Kit	2
KT742A	32-Bit EISA SCSI-2 Kit	2
KT747C	32-Bit EISA Fast SCSI-2 Kit	2
BT757S	32-Bit EISA Fast Wide SCS Card	3
KT946C	32-Bit PCI Fast SCSI-2 Kit	2
KT956C	32-Bit PCI Fast Wide SCSI-2 Kit	3
IDE CACHE CONTROLLERS		
KT510A	ISA/IDE Cache Controller	
KT410A	VESA/IDE Cache Controller	1
KT910A	PCI/IDE Cache Controller	1

DATA TECHNOLOGY

2278	Vesa local bus w/16550	$
2280	Super 10 card w/16550	
2130	PCI IDE controller	

SUPER CONTROLLERS

IDE CONTROLLERS		
211	2HD/2FD w/2 serial/1 Par/1 Game	$
243	2HD/2FD VLB EIDE w/io 2s/1p/1g	
400	16550 2HD/2FD 2-16550 2s/1p/1g ISA	
500	16550 2HD/2FD 2-16550 2s/1p/1g VLB	

DRIVE SPECIALS!

SEAGATE $169 420MB, IDE 11MS ST3491A

HEWLETT PACKARD $495 2.1GB, IDE 9.5MS C3725S

MODEMS

Supra

Supra Express 14.4 Internal	$74
Supra Express 14.4 External	94
Supra Express 28.8 Internal	142
Supra Express 28.8 External	169

PRACTICAL PERIPHERALS

14.4 Fax/Modem Internal	$75
14.4 Fax/Modem External	100
28.8 V.34 Fax/Modem Internal	199
28.8 V.34 Fax/Modem External	215

intel-PUREDATA

SatisFAXtion 200 Int	$249
SatisFAXtion 400 Int	299
SatisFAXtion 400 Ext	339

BOCA RESEARCH INC

14.4 Internal	$7
28.8 Internal V.34	16
28.8 External V.34	20

Hayes

Accura V.42 FAST 14.4 Internal
Accura V.42 FAST 14.4 External
Accura V.34 FAST 28.8 Internal
Accura V.34 FAST 28.8 External
Optima V.32 w/voice Internal
Optima V.32 w/voice External

USRobotics

Sportster 14.4 Internal
Sportster 14.4 External
Sportster 28.8/V.34 Internal
Sportster 28.8/V.34 External
Sportster VI 28.8 V.34 Int
Courier V.34 28.8/28.8 Internal
Courier V.34 28.8/28.8 External

CPU'S-INTEL-AMD-CYRIX

INTEL							
386DX-33	$35	486DX4-100	105	P-PRO 150	662	586K5-P75	89
486SX-25	35	PENTIUM 75	125	P-PRO 180	733	**CYRIX**	
486SX-33	35	PENTIUM 90	151	P-PRO 200	871	586-100	69
486DX-25	75	PENTIUM 100	181	**AMD**		586-120	90
486DX-33	45	PENTIUM 120	225	486DX2-66	$35	686-100(P120)	160
486DX2-50	45	PENTIUM 133	311	486DX4-100	40	686-100(P133)	231
486DX2-66	61	PENTIUM 150	437	486DX4-120	75	686-100(P150)	290
		PENTIUM 166	608	486DX4-133	59	686-100(P166)	501

DYNAMIC RAMS

1MB X 1-100NS	$6.00
1MB X 1-80NS	6.25
1MB X 1-70NS	6.50
1MB X 1-60NS	6.75
256K X 4-100NS	6.00
256K X 4-80NS	6.25
256K X 4-70NS	6.50
256K X 4-60NS	6.75

MATH CO-PROCESSORS

INTEL			80487SX-25 25MHZ	195
80387SX-16 16MHZ	$75		**CYRIX**	
80387SX-20 20MHZ	75		83D87DX-25 25MHZ	59
80387SX-25 25MHZ	75		83D87DX-33 33MHZ	59
80387DX-16 16MHZ	75		82S8XL 20MHZ	59
80387DX-20 25MHZ	75		**IIT/CHIPS**	
80387DX-25 33MHZ	75			
80487DX-33 33MHZ	75		387DX40MHZ	59

CACHE MEMORY

8X8-15	$5.00	32X8-25	7.80
8X8-20	4.50	64X1-15	15.00
8X8-25	4.00	128X8-20	30.00
32X8-15	16.00	128X8-25	25.00
32X8-20	8.00	128X8-15	40.00

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$545 3GB SCSI ST43400N HALF HEIGHT

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CD RECORDERS

2X CD Recorder
4X CD Reader

BEST VALUE!

Complete PC Internal with drive, mastering software, controller, & 5 disks	**$849**
Complete PC External with drive, mastering software, controller, & 5 disks	**$949**
Complete Mac External with mastering software & 5 disks	**$899**

4X CD Recorder
4X CD Reader

BEST PERFORMANCE!

Complete PC Internal with drive, mastering software, controller, & 5 disks	**$1219**
Complete PC External with drive, mastering software, controller, & 5 disks	**$1319**
Complete Mac External with mastering software & 5 disks	**$1269**

Hewlett Packard	**4Xr2Xw**	**Complete PC Kit**	**$989**	
Smart & Friendly	**2Xr2Xw**	**Complete PC Kit**	**$829**	
Pinnacle Micro	**4Xr2Xw**	**Complete PC Kit**	**$909**	
Yamaha bare drive	**2Xr4Xw**	**$749**	**4Xr4Xw**	**$1119**

CD ROM DRIVES

SCSI CD ROM (add $90 for external)

Sanyo	4X	190ms	$115	Sony	4X	250ms	$129
NEC	4X	200ms	$122	Pioneer	4.4X	140ms	$169
Plextor	4.5X	130ms	$249	Teac	6X	160ms	$245
NEC	6X	150ms	$269	Plextor	6X	145ms	$289
Toshiba	6.7X	120ms	$239	Plextor	8X	145ms	$415
Toshiba	8X	145ms	$299				

IDE (ATAPI) CD ROM

Mitsumi	4X	230ms	$65	Toshiba	4X	190ms	$71
Teac	6X	110ms	$119	NEC	6X	145ms	$99
Toshiba	6X	170ms	$99	Teac	8X	110ms	$169
Toshiba	8X	145ms	$159	NEW!	10X	130ms	$289

CD ROM CHANGERS

IDE-Internal

NEC 4X 4Disk $189 NEW! 3Disk 4X $155

SCSI-External

Pioneer	4.4X	DRM-624X	6 Disk	190ms	256K	$319
Pioneer	4X	DRM-1804X	8Disk	300ms	612K	$1899

7 Drive CD ROM TOWERS (1-21 Drive towers & other brands available!)

Sony 4X $1549	NEC 4X $1489	Pioneer 4.4X $2029
NEC 6X $2679	Toshiba 6.7X $2549	Toshiba 8X $3449

REMOVABLES

OPTICAL DRIVES

230MB	Fujitsu DynaMO Bare		$419
230MB	Fujitsu DynaMO Parallel Ext with 1 disk		$439
230MB	Fujitsu DynaMO PC Ext w/controller, & 1 disk		$499
2.6Gig	Maxoptix	Int/Ext	$1925/$2025
2.6Gig	HP	Int/Ext	$2125/$2225

SYQUEST DRIVES

EZ 135MB •13.5ms, 3600rpm, 128K buffer, 3 1/2" drive

Internal IDE with disk / External SCSI with disk	$190/$199
External parallel port with 1 disk	$249

270MB • 13.5ms, 3600rpm, 128K buffer, 3 1/2" drive

Internal IDE (SQ3270A)/ with 1disk (S3270AC)	$299/$339
External for parallel port with 1 disk	$429
SCSI drive (SQ3270S)/SCSI external(S3270X)	$339/$399

200MB •15.7ms, 3220rpm, 64K buffer, 5 1/4" form factor.

SCSI drive (SQ5200)/SCSI external(SQ5200CX)	$339/ $399

Genuine Syquest Media Qty 2-5/5-9/10+ or with drive

44MB $48/43/40	88MB $53/48/45	105MB $56/54/51
135MB $27/24/21	200MB $79/74/71	270MB $60/58/55

IOMEGA DRIVES

100MB ZIP • 3.5" x 1" high form factor

External SCSI w/ 1 disk	$199
Parallel External w/ 1 disk	$199

1 Gig JAZ • 3.5" x 1" high form factor

Internal SCSI w/ 1 disk	$499
External SCSI w/ 1 disk	$599

Adaptec controller A1505CDKIT only $49 when purchased with Zip or Jaz drive.

TAPE DRIVES

Prices include 1 free tape! Save $10 with hard drive!

1 Gig	Seagate	$159	800MB	Seagate	$141
1.7Gig	Seagate	$219	4.4Gig	Seagate	$259

Parallel External for printer port 1 Gig $269

SCSI TAPE DRIVES (bare, no tape)

2Gig	HP	DAT	$609	2-4Gig	Seagate	DAT	$679
2Gig	Seagate	DAT	$599	4-8Gig	Seagate	DAT	$859
2-4Gig	Seagate	QIC	$349	4-8Gig	HP	DAT	$879
2-4Gig	HP	DAT	$699	7-14Gig	Exabyte	8mm	$1889

HOT PRODUCTS

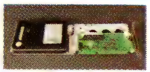
ExaByte 8mm EXB-8700 Tape Drive

The sleek, stand alone drive features a 7-gigabyte native, or 14-gigabyte compressed capacity, backup rate of up to 60 megabyte-per-minute. Complete backup kit includes: External drive w/ controller, cable, 1 tape, 1 cleaning tape, and a CD ROM w/ Arcada backup for DOS/WIN and your choice of Arcada for NetWare, Arcada for NT, Cheyenne for NetWare, or Palindrome backup director.

EXABYTE

$1489 alone or $1479 with hard drive purchase.

Add an Adaptec controller [A1505CDKIT] for only $49



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Out of drive bays? Looking for an easy way to upgrade your hard drive storage capacity? This hard disk card from *Smart Storage Solutions* is the answer. Just insert the card in a 16 bit slot. It comes preformatted and will work in any 386 or higher computer.

1Gig [SSS1GIG]	**$299**	**2Gig** [SSS2GIG]	**$439**
1.6Gig [SSS1.6GIG]	**$399**	**2.5Gig** [SSS2.5GIG]	**$499**

Fixed Disk Performance
With all the Removability Advantages

MCD

3 1/2" x 1" drive, 10ms 2 year drive warranty, 5 year cartridge warranty. Compatible with SyQuest 270 media.

Internal SCSI with 1 cartridge	$389
External SCSI with 1 cartridge	$449
Parallel Ext with 1 cartridge	$519

SCSI HARD DRIVES

SCSI	Speed	RPM	Brand	Model	Wty	Price
850MB	14ms	4500	Quantum	TB850S	3	$195
1050MB	9ms	5400	Seagate	ST31051N	3	$349
1080MB	11ms	5400	Seagate	ST51080N	3	$235
1280MB	12ms	5400	Quantum	FB1280S	3	$276
2050MB	8.5ms	7200	Micropolis	MC4221	5	$544
2050MB	8.5ms	7200	Micropolis	MC4221AV	5	$600
2147MB	9ms	5400	Micropolis	MC4421	5	$444
2147MB	9ms	5400	Seagate	ST32151N	5	$600
2147MB	8ms	7200	Seagate	ST32550N	5	$675
2150MB	8ms	7200	Quantum	XP32150	5	$630
4290MB	8ms	7200	Seagate	ST15150N	5	$989
4290MB	9ms	5400	Seagate	ST15230N	5	$905
4294MB	8.9ms	7200	Micropolis	MC3243	5	$859
4294MB	8.9ms	7200	Micropolis	MC3243AV	5	$945
4300MB	8.6ms	7200	Quantum	XP34300	5	$900
9091MB	12ms	5400	Micropolis	MC1991	5	$1840
9091MB	12ms	5400	Micropolis	MC1991AV	5	$1959
9080MB	11ms	5400	Seagate	ST410800N	5	$1880
WIDE SCSI						
2050MB	8.9ms	7200	Micropolis	MC4221W	5	$630
2050MB	8.9ms	7200	Micropolis	MC4221WAV	5	$689
2147MB	8ms	7200	Seagate	ST32550W	5	$675
2150MB	8ms	7200	Quantum	XP32150W	5	$680
4294MB	8.9ms	7200	Micropolis	MC3243W	5	$945
4294MB	8.5ms	7200	Micropolis	MC3243WAV	5	$1035
4294MB	8ms	7200	Seagate	ST15150W	5	$1065
4300MB	8.6ms	7200	Quantum	XP34300W	5	$959
9080MB	11ms	5400	Seagate	ST410800W	5	$2029
9100MB	12ms	5400	Micropolis	MC1991W	5	$1929
9100MB	12ms	5400	Micropolis	MC1991WAV	5	$2049

SCSI CONTROLLERS

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639MB	11ms	4500	Western Digital	AC2635	3	$170
850MB	10ms	4500	Western Digital	AC2850	3	$182
850MB	14ms	4500	Quantum	TB850A	3	$185
1080MB	11ms	5400	Seagate	ST51080A	3	$196
1080MB	9.5ms	5400	Fujitsu	M1606T	3	$209
1084MB	14ms	4480	Maxtor	M71084A	2	$200
1090MB	11ms	4500	Fujitsu	M1614T	3	$195
1250MB	15ms	3600	Quantum	BF1250A	3	$200
1280MB	12ms	5400	Quantum	FB1280A	3	$216
1280MB	10ms	5200	Western Digital	AC21200A	3	$205
1282MB	10.5ms	5400	Seagate	ST51270A	3	$207
1330MB	12ms	4480	Maxtor	M71336A	3	$207
1624MB	10ms	5200	Western Digital	AC31600	3	$249
1625MB	10.5ms	5400	Seagate	ST31640A	3	$275
1626MB	12ms	4480	Maxtor	M71626AP	3	$249
1700MB	11ms	4500	Quantum	SR31700A	3	$247
2004MB	12ms	4480	Maxtor	M72004A	3	$289
2100MB	10ms	5200	Western Digital	AC32100	3	$310
2167MB	10ms	5400	Seagate	ST32140A	3	$299
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DC600CD, 16Bit ISA, 4 IDE, 2 ATAPI, caching, RAID 1	$90
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Thinkpad 365E	2625W9A 586/100 8/540, passive	$2045
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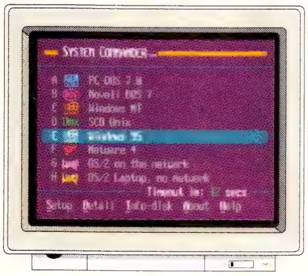

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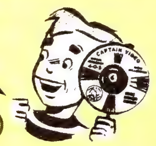

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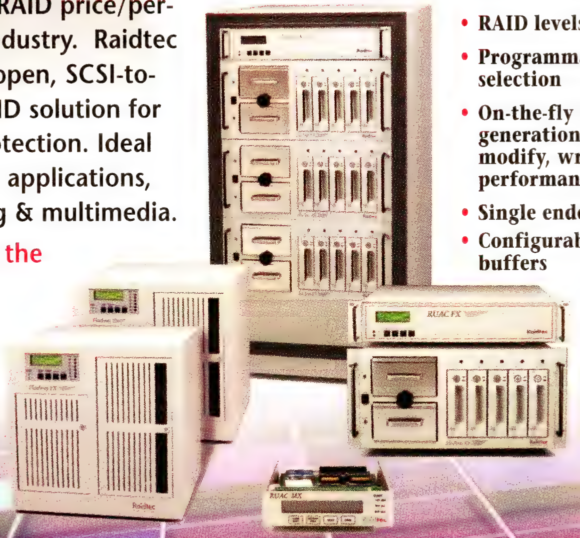

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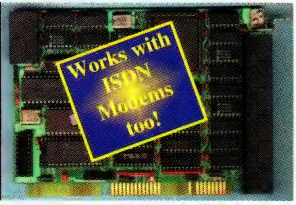

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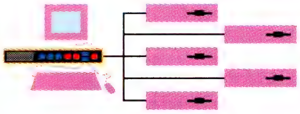

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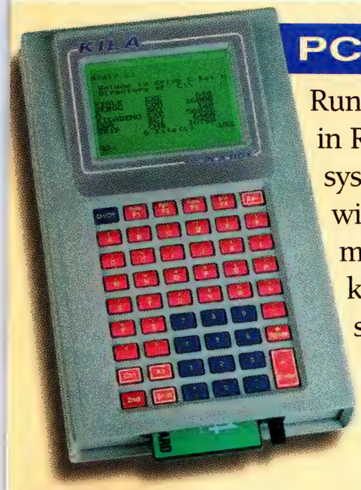

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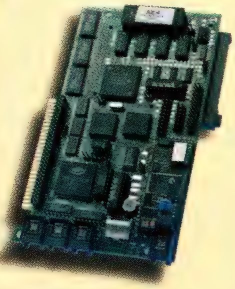

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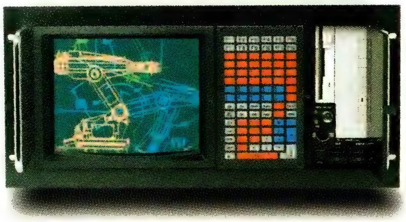

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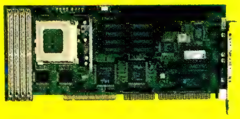

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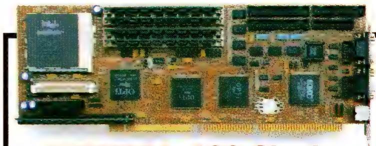

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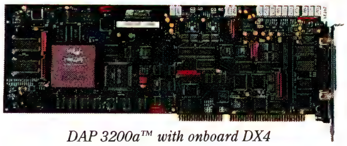

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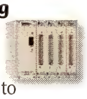

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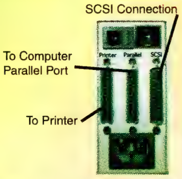

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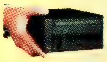

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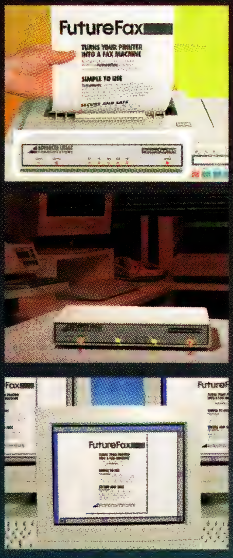

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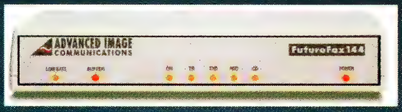

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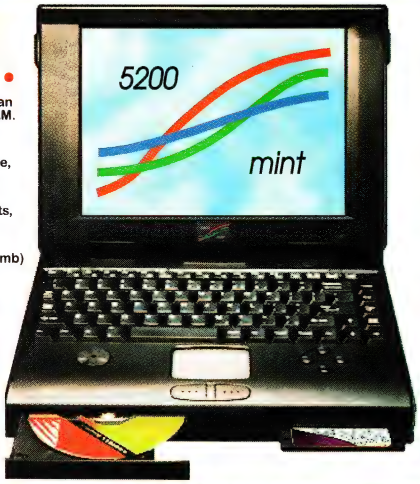

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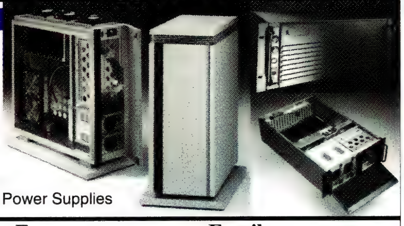

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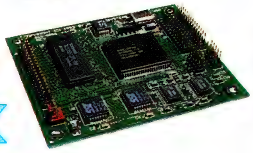

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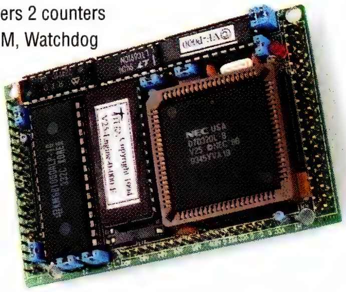

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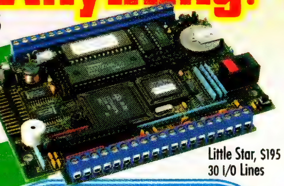

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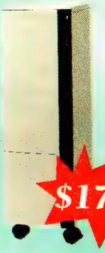

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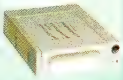

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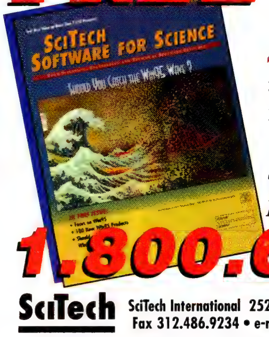

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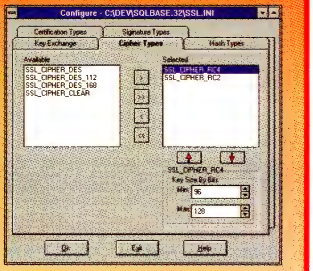

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AD FORMAT: Each ad will be designed and typeset by BYTE. Do NOT send logos or camera-ready artwork. Advertisers should furnish typewritten copy. **2"x1 1/16"** ads can include headline (23 characters maximum), descriptive text (300 characters is the maximum recommended) plus company name, address, telephone and fax number. **2"x2 5/8"** ad has more space for descriptive text (850 characters is the maximum recommended).

DEADLINE: Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 8. Send your copy and payment to: THE BUYER'S MART, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information please call Vivian Bernier in BYTE sales at 603-924-2521 or FAX: 603-924-2683.

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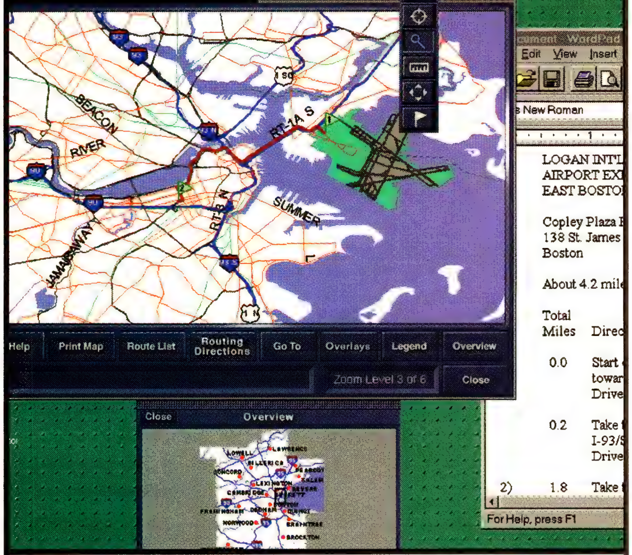
What's New

PREVIEW



Metro Navigator
$69.99

Circle 985
on Inquiry Card.

Philips Media Software
Los Angeles, CA
(800) 883-3767
(310) 444-6500
fax: (310) 445-5780
www.metronavigator.com

Navigate Cities Like a Local

Metro Navigator, a Windows CD-ROM program, can eliminate a big frustration in business or recreational travel—getting where you need to be when you don't know exactly where you are. The beta version I previewed came with maps for New York City, Baltimore/Washington, San Francisco, Los Angeles, Chicago, Boston, Orlando, and Atlanta and included information on such areas of interest as hotels, banks, and sports arenas. Once you enter your starting point and multiple destinations, Metro Navigator uses its digital mapping and routing databases to create detailed directions and a map with up to six levels of zoom and multiple overlays (e.g., subway stations, ATMs, and other points of interest).

The program accounts for one-way streets when it gives directions. But when I attempted to test the program's ability to give me alternative directions to points north of Boston from Logan Airport at a time when the tunnel to the airport is often congested with traffic, it directed me to the same tunnel instead of showing me the back way. It appears that Metro Navigator is not as savvy as a local limousine driver. However, it's quite good, and I plan to use it on my next trip to Chicago.

Now if only Philips would release a version with maps of Hannover, Germany, and Las Vegas—the sites of two major computer trade shows—I'd be a real happy camper. **—Dave Andrews**

Business

Reporting and Analysis Suite

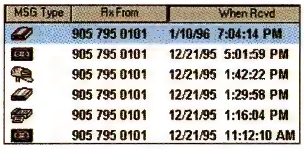
THE FOCUS SIX VISUAL BUSINESS INFORmation Suite's (from $295 per user) three-tier client/server architecture distributes application logic, business logic, and presentations among multiple computer platforms. Complex number crunching and aggregation take place on the server, so only the information you need is transported back down the network.

Contact: Information Builders, Inc., New York, NY, (212) 736-4433; www.ibi.com.
Circle 986 on Inquiry Card.

Communications

Integrated Windows Telephony Package

COMMUNICATE (US$179) COMBINES A contact manager, telephony features, fax transmission and monitoring capabilities, a graphics editor, and OCR capabilities under one program icon. The program lets you access and broadcast voice, fax, Internet e-mail, and data; retrieve voice, Internet e-mail, and fax messages from remote locations; and designate files for downloading.

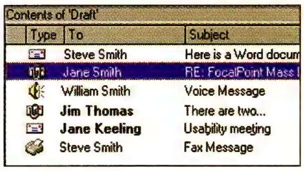


MSG Type	Fx From	When Rcvd
	905 795 0101	1/10/96 7:04:14 PM
	905 795 0101	12/21/95 5:01:59 PM
	905 795 0101	12/21/95 1:42:22 PM
	905 795 0101	12/21/95 1:29:58 PM
	905 795 0101	12/21/95 1:16:04 PM
	905 795 0101	12/21/95 11:12:10 AM

Contact: 01 Communique Laboratory, Inc., Mississauga, Ontario, Canada, (800) 668-2185 or (905) 795-2888; www.01.ca.
Circle 987 on Inquiry Card.

Integrated Windows Communications

STREAMLINE YOUR COMMUNICATIONS WITH FocalPoint (about $99), which brings together fax, data, e-mail, Internet, voice-mail, speakerphone, file-viewing, OCR, remote-access, and paging capabilities. A universal inbox manages fax, voice, and e-mail messages, and the program automatically retrieves e-mail from America Online, CompuServe, and the Internet.



Contents of 'Draft'

Type	To	Subject
	Steve Smith	Here is a Word docum
	Jane Smith	RE: FocalPoint Mass
	William Smith	Voice Message
	Jim Thomas	There are two...
	Jane Keeling	Usability meeting
	Steve Smith	Fax Message

Contact: Global Village Communication, Inc., Sunnyvale, CA, (800) 329-9675 or (408) 523-1000; www.globalvillage.com/.
Circle 988 on Inquiry Card.

Engineering

Mechanical Engineering

WITH MICROSTATION MODELER ($5325), you can graphically view, edit, and manage a mechanical design, including Boolean union and subtraction of feature trees and feature "reordering" with validity checking. You can do most design and viewing operations in rendered mode and automatically convert sketches to constrained models. MicroStation Modeler supports DOS and Windows PCs and Sun SPARC, HP RISC, SGI, and Digital Alpha workstations.

Contact: Bentley Systems, Inc., Exton, PA, (610) 458-5000; www.bentley.com/.
Circle 989 on Inquiry Card.

Software

The latest desktops and laptops boast Pentium processors running at up to 166 MHz, and lots of features. This month's lineup includes Cyrix's entry into the desktop PC arena and two multimedia notebook PCs.

Macintosh

Hierarchical Storage

By migrating unused files to secondary storage, the HSM Toolkit for Macintosh ($79) helps you manage crowded storage environments. The customizable rules-based system identifies migration candidates by tracking when files have been accessed, not just when they've been modified. You can cancel or defer migrations and anchor frequently used applications and documents.

Contact: FWB, Inc., Menlo Park, CA, (415) 325-4392; www.fwb.com.

Circle 990 on Inquiry Card.

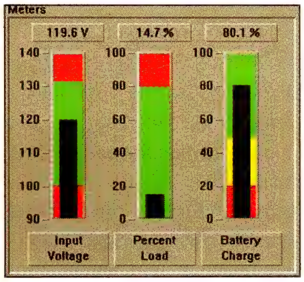
Networks

Manage a UPS

Designed to run on network servers or workstations, SmartMon (from $89, depending on your OS) monitors your UPS and, when critical events occur, performs an unattended system shutdown. The program provides user-defined actions for specific power events; Smart Messages; power-event logging; scheduling of system shutdowns, restarts, and self-tests on a daily, weekly, or monthly basis; and routines for creating customized graphs on-line.

Contact: Systems Enhancements Corp., Chesterfield, MO, (314) 532-2855; sales@sechq.com.

Circle 991 on Inquiry Card.



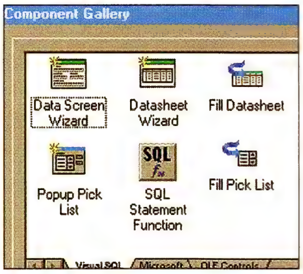
Programming

Visual C++ to Client/Server

Visual SQL ($1899) extends Visual C++ with visual designers, wizards, and object-oriented data access. You can create, modify, compile, and run your client/server applications inside Microsoft Developer Studio and define queries, SQL statements, tables, pick lists, and custom screens.

Contact: Blue Sky Software Corp., La Jolla, CA, (800) 459-2356 or (619) 459-6365; www.blue-sky.com.

Circle 992 on Inquiry Card.



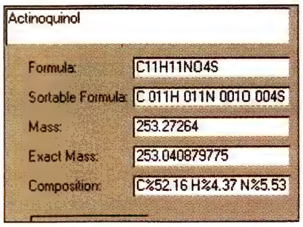
Science

Structure Drawing for OLE 2.0

With ChemWindow DB ($799), you can draw and edit structures from within OLE applications, drag and drop structures between OLE applications, and embed structures inside a chemical database system. The program includes tools for rings, bonds, templates, atom labels, arrows, charges, captions, and brackets; hot keys for labeling common groups and commands for styles, aligning, grouping, the chemistry checker, and calculations on mass, formula, exact mass, and composition; zooming from 12.5 percent to 800 percent; rotatable captions; and print preview.

Contact: SoftShell, Grand Junction, CO, (800) 242-6469 or (970) 242-7502; www.softshell.com.

Circle 993 on Inquiry Card.



Actinoquinol

Formula: C11H11NO4S

Sortable Formula: C 011H 011N 001O 004S

Mass: 253.27264

Exact Mass: 253.040879775

Composition: C%52.16 H%4.37 N%5.53

The Web

Secure Intranet Sites

Based on Windows Sockets technology, the Intranet Jazz Server Pro program ($2495) helps you construct a transparent security firewall component between your corporate intranet and the Internet or between individual intranet subnets. The program, a component for JSB's Intranet Jazz Server, can also serve as a secure gateway between a NetWare IPX LAN and a TCP/IP backbone.

Contact: JSB Corp., Scotts Valley, CA, (800) 572-8649 or (408) 438-8300; www.jsb.com.

Circle 994 on Inquiry Card.

Internet Access CD-ROM Package

ExpressNet Suite ($49.95) includes free Internet access from EarthLink Network; EarthLink Total Access software, which includes Netscape Navigator 2.0; SurfWatch, which lets you block and restrict Internet access; VocalTec's Internet Phone, which lets you participate in real-time, two-way Internet phone conversations worldwide without incurring long-distance telephone charges; APTE's Internet Coach Netscape tutorial; and multimedia plug-ins that let you "fly" through 3-D virtual-reality scenes and access real-time audio, multimedia animations, slide shows, and live video while exploring the Internet.

Contact: EarthLink Network, Inc., Pasadena, CA, (800) 395-8410 or (818) 296-2400; info@earthlink.net.

Circle 995 on Inquiry Card.

Web-Browsing Control

You can use WebViewer ($249) in visual development environments to integrate browsing of the Web and HTML documents into Windows-based applications. WebViewer provides access to the entire browser environment, including defining the appearance of the browser window and its contents. You can set the default appearance of Web pages and preprocess HTML documents before you load the contents in the viewer window.

Contact: Visual Components, Inc., Lenexa, KS, (800) 884-8665 or (913) 599-6500; www.visualcomp.com.

Circle 996 on Inquiry Card.

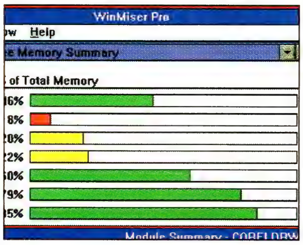
Unix

Print Unix Files on Color Printers

Now you can print Unix applications and images on wide-carriage color plotters and color ink-jet, dye-sublimation, thermal-wax, and laser printers. PostShop ($200 to $1600, depending on configuration) automatically detects the formats of the documents and images you send to its print queue; it also includes a PostScript Level 2 software RIP and 35 fonts.
Contact: Vividata, Inc., Berkeley, CA, (510) 841-6400; www.vividata.com.
Circle 997 on Inquiry Card.

Utilities

Analyze Windows Memory Usage



With WinMiser Pro ($59), you can protect Windows DOS memory, analyze insufficient-memory errors, and recover memory lost due to programs "leaking" memory. The utility keeps track of how much memory in the system-resource areas each program is using. Based on this accountability, the program knows when problems occur and which application is responsible. WinMiser Pro checks every request for low memory, tells you why insufficient-memory errors occur and how much memory your programs are using, helps you decide which applications you can run together and which you need to close; and alerts you when a program leaks—and then enables you to free up this memory.
Contact: Chicago-Soft, Ltd., Hanover, NH, (603) 643-4571; www.quickref.com.
Circle 998 on Inquiry Card.

SOFTWARE UPDATES

Wildcat 5 BBS/Web Server for Windows 95/NT includes real-time and threaded messaging, file management, interactive teleconferencing, data security, HTML graphics, e-mail, and Internet integration. Two users, $149; 16 users, $349; 32 users, $699.
Contact: Mustang Software, Inc., Bakersfield, CA, (800) 999-9619 or (805) 873-2500; www.mustang.com.
Circle 999 on Inquiry Card.

A 32-bit OCR application, **TextBridge Pro 96** provides SoftQuad's HotMetal Light 2.0 Web editor; support for Windows 95 and NT; expanded input formats; and drag-and-drop operation with Visioneer's PaperPort software, a link that also supports Compaq's Keyboard Scanner and Hewlett-Packard 4 Series scanners. About $260.
Contact: Xerox Imaging Systems, Inc., Peabody, MA, (508) 977-2000; www.xerox.com/products/tbpro/.
Circle 1000 on Inquiry Card.

A tool for integrating data among applications, relational databases, and Lotus Notes, **Prospero 1.1** lets you access data from the Web, implement a CGI script as a visual program, encapsulate new applications in addition to those supported by Prospero's application building blocks, and create custom building blocks for specific applications. $695.
Contact: Oberon Software, Inc., Cambridge, MA, (617) 494-0990; www.oberon.com.
Circle 1001 on Inquiry Card.

HARDWARE

Accessories

Adjustable IBM-Compatible Keyboard

You can use the PerfecTouch 101 Keyboard ($89) in a variety of angles and multiple positions, separate it into two parts, or use it in a conventional position.
Contact: PerfecTouch, Inc., Chicago, IL, (800) 859-2225 or (312) 258-0888.
Circle 1004 on Inquiry Card.

Connectivity

Wireless Printing Adapter

AirPrint Network ($300 per unit) allows wireless printer sharing with up to eight network printers. You connect the adapter to the parallel port of a server or print server.
Contact: Connectware, Inc., Richardson, TX, (800) 357-0852 or (214) 997-4111; www.connectware.com.
Circle 1005 on Inquiry Card.

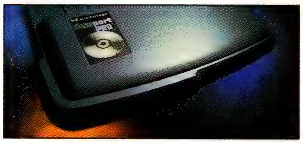
PC-Based Remote Access

Remote-access solutions for dial-in telecommuting and dial-out modem-pool applications, RemoteMates (four-user version, $1335; eight-user version, $2395) combine an asynchronous multiuser board with NetWare Connect software for TCP/IP, IPX/SPX, and AppleTalk users supporting client/server applications. Adapters are available for Token Ring and Ethernet networks.
Contact: NDC Communications, Inc., San Jose, CA, (800) 632-1118 or (408) 428-9108; www.ndclan.com.
Circle 1006 on Inquiry Card.

Remote and Internet Access

The Allegra internal ISA/EISA cards for PCs ($549 to $1995) integrate remote access and routing technology into Windows NT or Novell NetWare servers. With the Allegra cards, you can use your NT or NetWare server as an Internet access server and build Web pages, Internet mail services, FTP sites, and other services. The cards support data transfer speeds from 56 Kbps to 1.536 Mbps.
Contact: U.S. Robotics Corp., Skokie, IL, (800) 877-2677 or (847) 470-7900; www.usr.com.
Circle 1007 on Inquiry Card.

Workgroup CD-ROM Sharing for NT



DiscPort Pro ($1595) can support up to 14 six-speed CD-ROM drives on 10-Mbps Windows NT networks. You can use either Thin Ethernet or 10Base-T network connections, and DiscPort Pro works with popular CD-ROM drives, towers, and disc changers. A single DiscPort Pro unit supports Novell NetWare and Windows NT, and a network can support multiple DiscPort Pro units.
Contact: Microtest, Inc., Phoenix, AZ, (800) 526-9675 or (602) 952-6400; www.microtest.com.
Circle 1008 on Inquiry Card.

Peripherals

TouchPen CRT Monitors

The TouchPen Monitors combine MicroTouch TouchPen technology, which can accept finger or pen input and distinguish one from the other, with a high-resolution 15-inch ($1595) or 17-inch ($2125) Mitsubishi Diamond Scan CRT display. You get a touch resolution of

BIX: Your Coach to the Internet!

Photo by Dana Simmons

The Internet connects you with more than 10 million people , at universities, companies, and other online services. Now, get full access to the Internet free of charge when you subscribe to BIX! You'll also get expert assistance from BIX moderators who can help you find your way around the Internet.

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Give BIX a try with our new 5 for Free Offer! Join BIX today and get 5 hours of evening and weekend access for free! Take the rest of the calendar month to explore BIX, and then continue for our standard $13 monthly membership fee. Further details and complete rate information are provided during registration. Using any communications program, dial 1-800-695-4882. At the "logon" prompt enter bix. Then at the "name?" prompt enter bix.byte39. If you have any questions, call us at 1-800-695-4775 (voice). Or fax us at 617-491-6642. Send Internet mail to info@bix.com. Windows users can order BIXnav, our graphical interface for BIX, for easy point and click access. Details are available during registration.

BIX

If you can hack it

Under the 5 for Free plan, daytime rates ($9/hr.) apply for access during prime time hours. The 5 for Free offer is valid for first-time members only.

Circle 450 on Inquiry Card.

1024 by 1024 pixels in finger mode and 2048 by 2048 in pen mode. The monitors are SVGA compatible with a maximum resolution of 1280 by 1024 noninterlaced and a dot pitch of 0.28 for the 15-inch model and 0.31 for the 17-inch model.
Contact: MicroTouch Systems, Inc., Methuen, MA, (800) 642-7686 or (508) 659-9000; www.microtouch.com.
Circle 1009 on Inquiry Card.

PREVIEW

Planet-ISDN GeoPort Adapter
$495

Circle 1003 on Inquiry Card.

Sagem
Cupertino, CA
(408) 446-8690
fax: (408) 446-9766
www.satusa.com

ISDN for the Macintosh

ISDN capability for the Mac has been somewhat hard to find lately. While PC solutions abound, Mac users hoping for high-speed serial connectivity have had to wait. Happily, their anticipation is over now that Sagem has released the Planet-ISDN GeoPort Adapter.

The concept behind the Planet-ISDN GeoPort Adapter is straightforward. Plug the pod into a Mac's GeoPort connector, plug an ISDN line into the GeoPort, and connect to on-line services, the Internet, and other Macs at ISDN speeds.

Unfortunately, the ISDN GeoPort is an S/T interface device. Thus, it requires an external Network Terminator (NT1). A built-in NT1 would have made installation easier and less expensive.

We tested the ISDN GeoPort on a Quadra 660av and a Power-Mac 7500. With compression, files consistently transferred between the Macs at 121 Kbps–more than four times the top speed of a 28.8-Kbps modem.

The units performed well except when we attempted a PPP connection with a Cisco CB 900 ISDN PRI brouter. The GeoPort was able to make the connection, but it failed when authenticating. At press time, the company was attempting to resolve this problem.

For Mac users longing to surpass the 14.4-Kbps performance of Apple's current GeoPort, owning the Sagem Planet-ISDN GeoPort Adapter may prove to be a satisfying experience. **–Jeffrey Fritz**

PREVIEW PHOTOGRAPH: LIGHTWORKS PHOTOGRAPHIC, INC. © 1996

Eight-Speed CD-ROM Drive

THE CD-58E DRIVE (ABOUT $200), WHICH includes an Enhanced IDE interface, and the CD-58S drive (call company for price), which has a SCSI connector, provide 1200-Kbps data transfer rates, 128-KB buffers, 110-ms seek times, and 140-ms average access times. The drives support one-, two-, three-, quad-, and six-speed CD-ROM formats; in addition, they are compatible with Video CD, CD-ROM Mode 1 and Mode 2, XA Ready, CDI, and CD Plus formats.
Contact: Teac America, Inc., Montebello, CA, (213) 726-0303.
Circle 1010 on Inquiry Card.

Large-Document Scanner

TRUSCAN FLASH ($24,995) CAN SCAN A black-and-white E-size document in less than 15 seconds at 400 dpi and in 7.5 seconds at 200 dpi. Using Vidar's proprietary Adaptive Area Thresholding on poor-quality originals, the scanner analyzes variations in contrast and background tone and adjusts the threshold level as necessary. The bundled scanner-control software allows the use of such editing and viewing tools as despeckle, cut, copy, paste, zoom, pan, and rotate.
Contact: Vidar Systems Corp., Herndon, VA, (800) 471-7226 or (703) 471-7070; sales@vidar.com.
Circle 1011 on Inquiry Card.

15-inch Multimedia Color Monitor

THE MM6536SL MONITOR'S SOUND system has its speaker grill and volume-control, microphone, and headset sockets built into the front of the bezel. The MM6536SL multimedia color monitor ($445) features a horizontal frequency of 30 to 64 kHz, a vertical refresh rate of 50 to 100 Hz, a 1280- by 1024-pixel noninterlaced resolution, and a 0.28-mm dot pitch. The flat-square CRT has an enhanced nonglare, antistatic coating and an Invar shadow mask.
Contact: Smile International, Inc., Costa Mesa, CA, (800) 876-4532 or (714) 546-0336; smilekfc@aol.com.
Circle 1012 on Inquiry Card.

Storage

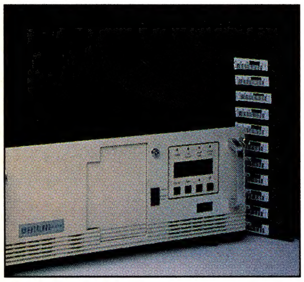
All-in-One Storage Expansion Kit

IF YOU'RE LOOKING FOR FUTURE EXPANSION options for your PC's internal IDE/Enhanced IDE hard drive, then the Adaptec Power Storage Hard Drive Kit ($599) may be of interest to you. The kit, which comes in ISA and PCI versions, combines a 1-GB external hard drive, a host adapter, and Vertisoft's Remove-It software, which enables you to delete Windows and DOS applications and files that you no longer need.
Contact: Adaptec, Inc., Milpitas, CA, (800) 959-7274 or (408) 945-8600; www.adaptec.com.
Circle 1013 on Inquiry Card.

Plug-and-Play Hard Drives for Notebooks

The Easy Plug-Easy Go external and Remove'n'Replace internal removable hard drives increase storage capacity on AST, Compaq, Hewlett-Packard, IBM, NEC, and Toshiba portable PCs. The 810-MB drives ($663 each) have average seek times of 14 ms and data transfer rates of up to 36 Mbps to and from storage media. The 1.3-GB drives ($927 each) have average seek times of 13 ms and data transfer rates of 44.9 Mbps to and from storage media.
Contact: CMS Enhancements, Inc., Anaheim, CA, (714) 517-0915; info@cmsenh.com.
Circle 1014 on Inquiry Card.

Scalable Storage



The first component of the LibraryXpress automated tape library system is the LXB base module with one or two DLT2000XT or DLT4000 tape drives and 10 cartridges, generating a storage capacity of 300 to 400 GB with a data transfer rate of more than 10 GB per hour. The LibraryXpress LXB (from $10,995) supports leading backup, archival, and HSM applications running under NetWare, AIX, SCO, HP-UX, Sun OS, Solaris, Mac OS, and NT.
Contact: Overland Data, Inc., San Diego, CA, (619) 571-5555; www.ovrland.com/odisales.
Circle 1015 on Inquiry Card.

Systems

Cyrix Windows 95 PCs

Available in minitower or desktop cases, the Cyrix 6x86 PCs (from $2399) offer P133, P150, or P166 processors; 256 KB of synchronous pipeline burst cache; 16 MB of 60-ns EDO DRAM; a 1.6- or 2.1-GB Enhanced IDE hard drive; a 3½-inch 1.44-MB floppy drive; 64-bit PCI video with 2 MB of EDO DRAM or Matrox MGA Millennium video with 2 MB of WRAM; a six-speed EIDE CD-ROM drive; Sound Blaster 16-bit stereo sound or Sound Blaster AWE32 wave-table sound; Labtec LCS-1021 stereo speakers or a Cambridge SoundWorks speaker system; a 28.8-Kbps fax/modem/phone answerer; a 15- or 17-inch monitor; a 104-key keyboard; a mouse; and Windows 95.
Contact: Cyrix Corp., Richardson, TX, (800) 340-7501 or (214) 968-8388; www.cyrix.com.
Circle 1016 on Inquiry Card.

Multimedia Notebook with PD Drive

The PD drive on the CF-62 multimedia notebook PC (call company for price) enables you to read from and write to a 650-MB rewritable optical disk or a quad-speed CD-ROM.

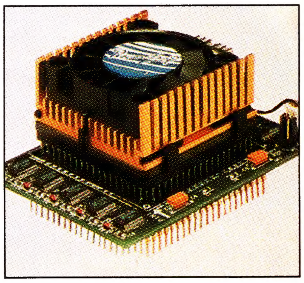
The CF-62 system comes with a 100- or 133-MHz Pentium CPU with 256 KB of L2 cache, 32-bit PCI bus architecture, 8 or 16 MB of EDO memory (expandable to 48 MB), a 12.1-inch 1024- by 768-pixel XGA or 800 by 600 SVGA color LCD, up to 1.35 GB of disk storage, a GlidePoint touchpad, a Chips & Technologies graphics controller, 2 MB of EDO video memory, a PC Card slot that accepts two Type II or one Type III PC Card, and a lithium-ion battery. The Multimedia Pocket, which houses the floppy drive, enables you to use the floppy drive and the PD/CD-ROM drive simultaneously; it also accepts the CF-VEV611W MPEG decoder pack with NTSC output for full-screen, full-motion video playback of MPEG and Video CD files.
Contact: Panasonic Personal Computer Co., Secaucus, NJ, (800) 662-3537 or (201) 271-3182; www.panasonic.com.
Circle 1017 on Inquiry Card.

120-/133-MHz Pentium Notebooks

A fully loaded OpenNote notebook PC (from $1599) comes with a PCI-based 120- or 133-MHz Pentium processor; 16 MB of RAM, which is expandable to 64 MB; a removable 810-MB hard drive; a 3½-inch removable floppy drive; two Type II or one Type III PC Card slot; an 88-key keyboard with Windows 95 function keys; a touchpad pointing device; a 10.4- or 11.3-inch DSTN or TFT SVGA color display; a dual NiMH detachable/rechargeable battery supply; an AC power adapter; and Windows 95. Multimedia features include a quad-speed CD-ROM drive; two stereo speakers; 3-D sound and Sound Blaster Pro 16-compatible MPEG support; a microphone; and audio ports.
Contact: Kiwi Computer, Inc., Santa Clara, CA, (408) 492-9188; kiwinote@kiwicom.com.
Circle 1018 on Inquiry Card.

Upgrades

Supercharge Your 486 and Pentium PCs



The SpeedStack family of microprocessor upgrades includes the SpeedStack I, which upgrades Pentium 60-/66-MHz systems to Pentium 100-/120-/133-MHz PCs; the SpeedStack II, which upgrades 486SX/DX/DX2 systems to 586 100-/200-/133-MHz systems; and the SpeedStack III, which upgrades 486SX/DX/DX2 PCs to 486DX4 75-/100-/120-MHz PCs. The upgrades are Windows 95 and OS/2 Warp compatible and can perform multimedia and full-motion video-image processing.
Contact: Alpha Systems Lab, Inc., Irvine, CA, (714) 622-0688.
Circle 1019 on Inquiry Card.

Video

Digital Video Card for the Mac

With miroMotion DC20 ($999), you can edit and store complete video productions as QuickTime files on your hard disk and then output to videotape in Super-VHS, VHS, Hi8, and Video8 formats. The PCI-based card's capabilities include real-time video capture at up to 60 NTSC fields per second (50 PAL fields per second), hardware-based motion-JPEG compression on the fly, and frame-accurate nonlinear editing with Adobe Premiere LE, which is included in the package.
Contact: Miro Computer Products, Inc., Palo Alto, CA, (800) 249-6476 or (415) 855-0955; www.miro.com/.
Circle 1020 on Inquiry Card.

Digital Imagery

DC20

under $350

Eastman Kodak Co.
(800) 235-6325
www.kodak.com
Circle 983 on Inquiry Card.

PDC-2000

$4995

Polaroid Corp.
(716) 256-4436
www.polaroid.com
Circle 984 on Inquiry Card.

Forget film and scanners. With these state-of-the-art digital cameras, you can include real-world objects like people and products in your business documents as easily as plugging into a SCSI or serial port and downloading an image. Within a few years, you'll find the low cost of the Kodak DC20 and the high resolution of the Polaroid PDC-2000 in the same device.

The PDC-2000 holds up to 60 images.

You won't find better resolution (1600 by 1200 pixels, 16.7 million colors) unless you spend several times more. At snapshot sizes, that's as good as Kodacolor.

SCSI connection keeps image-transfer time down to several seconds.

Software includes TWAIN drivers, plug-ins for Adobe Photoshop, and a stand-alone application for basic editing.

With a best-case resolution of 493 by 373 pixels, DC20 images are fine for insurance and real estate shots.

184,000-pixel-per-image resolution does not require a SCSI connection—the serial port will do.

For less than $350, you can't beat this easy-to-use 4.2-oz. pocket-size model. The camera's 1 MB of memory stores 16 low-res or 8 medium-res images.

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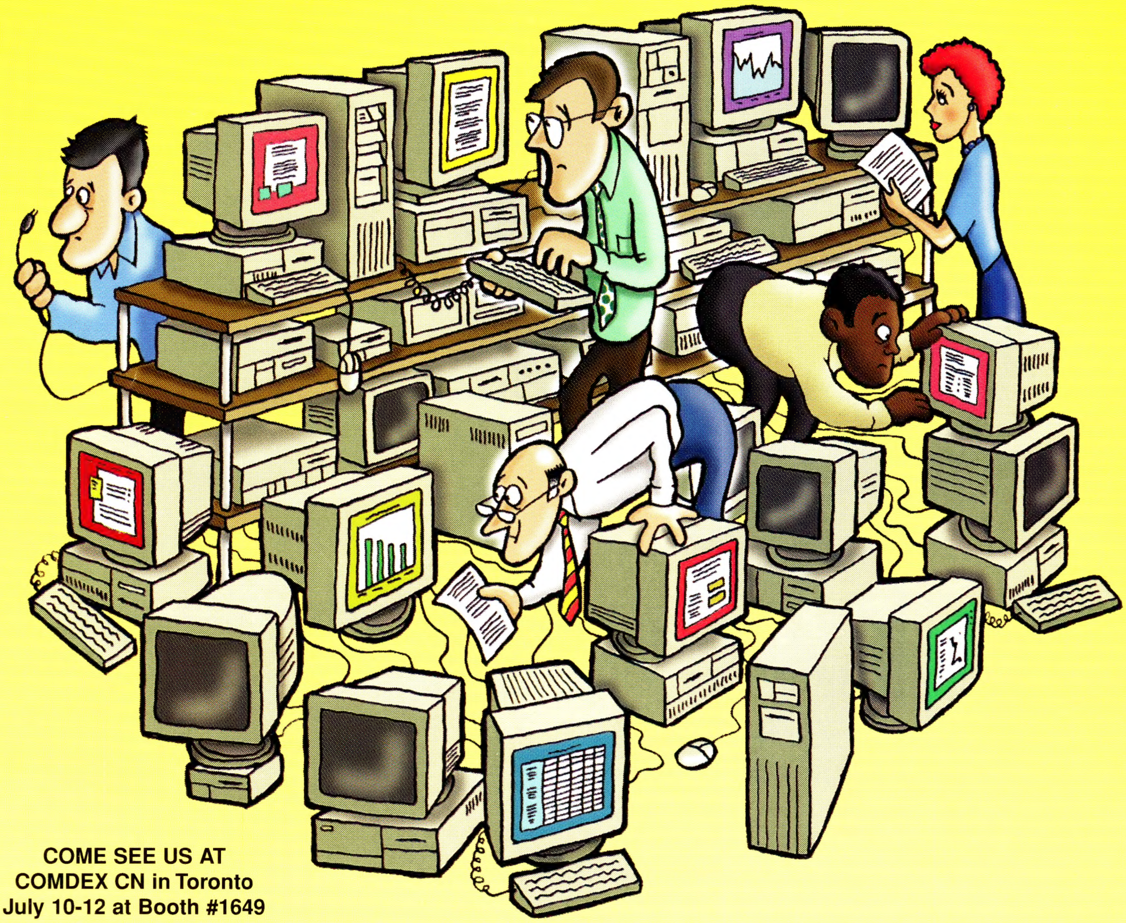

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Circle 702 on Inquiry Card (RESELLERS: 703).